THE

PHILOSOPHICAL WORKS

OF

FRANCIS BACON,

Baron of *Verulam*, Viſcount *St. Albans*,

and LORD HIGH-CHANCELLOR of *England*;

Methodized, and made *Engliſh*, from the ORIGINALS.

WITH

OCCASIONAL NOTES, to EXPLAIN what is Obſcure;

And ſhew how far the ſeveral PLANS of the AUTHOR, for the Advancement of all the Parts of Knowledge, have been executed to the preſent Time.

In THREE VOLUMES.

By *PETER SHAW*, M. D.

VOL. III.

Multi pertranſibunt, & augebitur Scientia.

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BRITISH MUSEUM

INSTAURATION

PART III.

BRITISH MUSEUM

INSTRUCTION

PART III.

PREFACE.

THIS third Part *of the* INSTAURATION *ſeems to have been generally miſapprehended; perhaps for want of carefully attending to its Office and Uſe, as they are diſtinctly laid down in the* Novum Organum[a]; *and farther explained in the Author's* Aphoriſms for compiling a juſt Hiſtory of Nature and Art[b].

Indeed, the Work being poſthumous, and uſually publiſhed ſeparate, the Connexion it has with the other Parts of the Inſtauration, *could not be fully diſcovered, without more than ordinary Diligence, and Attention: whence it has been too much conſidered with regard to itſelf, or the direct Matter it contains; and not ſufficiently, as it ſets an Example for proſecuting, and, in ſome degree, executes, a principal Part of the Author's general* Scheme *for the* Rebuilding of Arts, Sciences, and all human Knowledge, *from their ſureſt Foundations: wherein its principal Merit and Excellence conſiſt*[c]. *For the Deſign and Tendency of this Work, is to lay the Foundations of* Inductive Hiſtory; *a Thing, ſo far as appears, never attempted before*[d].

The Sylva Sylvarum, *therefore, is to be conſidered as a Collection of the beſt Materials, which the Author, by his ſingle Abilities, could, in his own Time, procure, in order to this End; that is, to furniſh out a proper Set of* particular Hiſtories, *for the due* Interpretation of Nature; *the Diſcovery of* Cauſes; *the Inveſtigation of* Forms; *and the raiſing of* Axioms; *that ſhould not only direct a general* Practice, *or the Perfection of Arts; but alſo conſtitute a general* Theory *for perfecting the Underſtanding*[e]. *And if it be carefully remembered, that this was the Author's View in collecting the* Sylva Sylvarum, *the Performance will*

[a] Part I. *Aph.* 117, 118, 119, 120, 121. Page 405——409.
[b] See Vol. III. pag. 8——16.
[c] See Vol. I. pag. 13, 14, 15, 44——47.
[d] See the *de Augmentis Scientiarum* pag. 44. *Novum Organum* Vol. II. pag. 393. and Vol. III. pag. 5.
[e] See the *Novum Organum* Part I. paſſim. And Part II. Sect. I. throughout.

will doubtleſs appear of a much higher, or nobler Nature, and to be better executed, than Men have hitherto generally imagined.

And whoever duly conſiders the Thing, will not wonder that the End and Deſign of the Sylva Sylvarum *ſhould have been miſconſtrued; when the* Novum Organum, *which was to be wholly employed upon it, has been ſo little underſtood: the one being only a part of the* Matter, *and the other a part of the* Inſtrument, Engine, *or* Crane, *for raiſing Arts and Sciences, to their greateſt Perfection.*

It muſt, indeed, be acknowledged, that the Sylva Sylvarum *is far from perfect; or from anſwering the Deſign of a general* Hiſtory of Nature and Art, *in all that Extent and Fullneſs conceived in the Mind of the Author. And thus much is freely confeſſed by himſelf*[f]; *when he ingenuouſly declares, that "the* Natural Hiſtory *he has been "able to procure, is not ſo copious, and ſo well verified, as* alone *to "ſerve for, or even adminiſter to, a genuine Interpretation of Nature." And again, that "it is a royal Work, requiring the Purſe of a Prince, "and the Aſſiſtance of a People; the Materials of the Underſtanding "being ſo diffuſive, that they muſt, like Merchandize, be imported from "all Quarters," &c.*[g] *It were, therefore, extremely ſupine, and inconſiderate, to expect that from the Labours of a ſingle Perſon (otherwiſe ſufficiently employed) which is, in reality, the Work of many; and, if proper Care be not taken, may prove the Work of Ages. We are likewiſe to conſider, according to the Intimation given above, that the Work did not receive the laſt Hand of the Author; and, being publiſhed after his Death, is, on that Account, not ſo correct as it would have been, had he lived to reviſe, and ſit upon it, from Year to Year, in his uſual manner. But imperfect as he left it, perhaps it may ſtill be found a Work ſingular in its kind; and hitherto unequalled; or rather, not carefully continued. For it might be proper, with prudent Moderation, and ſuitable Deference, to enquire, what has been done towards perfecting this general* Hiſtory of Nature and Art, *ſince the Time of the Author; upon the Plan which he left us, and the Light he afforded for the Purpoſe. And, with due Reverence and Reſpect to the paſt and preſent Age, it ſhould ſeem as if the Author's Intention had been ſomewhat miſtaken; or at leaſt, as if his Example had not been exactly followed.*

'Tis certain, that noble Collections of philoſophical Materials have been made in England, France, Germany, *&c. as appears in the* Philoſophical Tranſactions *of the* Royal Society *of* London; *the* Memoirs of the Royal Academy of Sciences at *Paris*; *the* Acta Eruditorum, *and* Ephemerides *of the* German *Academicians*, &c. *But ſurely the Matters*

[f] See *Novum Organum* Part I. *Aph.* 117. See alſo Vol. I. pag. 13——15, 44——47.
[g] Vol. III. pag. 6, 7. *Novum Organum* Part I. *Aph.* 98, 111, &c.

Matters thus collected, and treaſured up, tho highly excellent and uſeful, ſeem rather accidental, or caſual; as Things themſelves happen to turn up; or as Mens Studies and Inclinations prompt and lead; than purpoſely ſought out, with a View to Inductive Hiſtory, *and* Axiomatical Philoſophy. *And hence it happens, that when any particular* Natural Enquiry *is gone upon, in the* Inductive Method, *we even at this Day are at a loſs for the* Prerogative Inſtances, *capable of leading, in a ſhort way, to a juſt Determination. So that the Perſons who ſhould act the Part of* Interpreters of Nature, *are obliged to turn* Hiſtorians; *and inſtead of exerciſing the Underſtanding in forming a proper* Induction, *are obliged to go in queſt of Materials; and themſelves procure the requiſite Facts, and make the needful Obſervations and Experiments. No wonder, therefore, if the Structure of ſerviceable and effective Philoſophy riſes ſlowly, when the Materials for it are not yet collected, and brought together, into any one, two, or more, general Repoſitories.*

Barely to intimate this may ſuffice for the preſent, in order to bring us better acquainted with what the Author means by Induction; *the Inveſtigation of* Forms; *and the Interpretation of* Nature; *that is, with the little regarded, but immenſely uſeful Doctrine of his* Novum Organum, *or* Philoſophical Algebra; *which, as we above obſerved, was to be ſolely employed upon proper Materials, collected in the manner of the following* Memoirs *for a* Hiſtory of Nature and Art; *ſo as, in due time, to procure a general Syſtem of* Inductive Hiſtory; *in exact Conformity with Nature herſelf.*

Such was the View and Deſign of the following Memoirs: *and to render them the more ſubſervient to this End, the fitter for Uſe, and the more capable of Improvement, we have altered their Order; and, according to the Author's Direction, placed them in the Storehouſe, or Repoſitory, ſo as to be readily found, when they come to be wanted: that is, we have placed them in* Alphabetical Order; *which ſeems, in a particular manner, to ſuit the Rudiments of natural Knowledge, and the Embryo of* ſcattered Hiſtory.

The Notes *occaſionally added, we hope, will more fully open the Deſign and Scope of the Piece; ſo as to render it generally intelligible; and lead to its farther Advancement.*

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SYLVA SYLVARUM:

THE

Phænomena of the Universe;

OR, THE

MODEL of a REPOSITORY of MATERIALS,

For Erecting a Solid and Serviceable

PHILOSOPHY,

On the Basis of

EXPERIMENT and OBSERVATION.

STELLA STELLARUM:

THE

Phænomena of the Universe;

OR, THE

MODEL of a REPOSITORY of MATERIALS,

For Erecting a Solid and Serviceable

PHILOSOPHY,

On the Basis of

EXPERIMENT and OBSERVATION.

BRITISH MUSEUM

SYLVA SYLVARUM:

THE

Phænomena of the Universe, &c.

INTRODUCTION.

SECT. I.

Of the just Method of compiling a NATURAL *and* EXPERIMENTAL HISTORY; *for the Service of* PHILOSOPHY, *or the farther Discovery and Advancement of Arts and Sciences.*

1. AS Mankind appear to us unacquainted with the ways both of *judging* and *experimenting*, we would attempt to remedy this Misfortune; and cannot perhaps deserve better of them, than by endeavouring to free them from the tyranny of *false Doctrines* and *Theories*; raise them from the Languor they lie under with regard to *Experiments*; and bring them, by a kind of *learned Experience*[a], to a more close and exact Acquaintance with things themselves: so that the Understanding, being placed upon a secure Eminence, may discover the ready way of procuring of all the more useful and necessary things. *The Design of the ensuing History.*

2. The foundation of this Design must be laid in a *History of Nature*; for all the Philosophy at present received, appears to us built upon too narrow a Basis of *Natural History*; and to have pronounced upon too few Premises. For having seized on certain Traditions of Experience; and this sometimes without a careful Examination; Men have trusted every thing else to *The Foundation of the Design.*

[a] See the *De Augmentis Scientiarum*, Sect. XII. of LEARNED EXPERIENCE.

Contemplation, Genius and Diſpute; with the aſſiſtance only of the *common Logick* for their better Security.

An Exhortation to Men for Recovering their Dominion over the Works of Nature; drawn from the Differences of Opinions.

3. But they are to be admoniſhed, and earneſtly intreated, as they value their own Happineſs, to humble their Minds; and look for the *Sciences* in the great World about them: for unleſs a careful and approved *natural* and *experimental Hiſtory* be procured, we muſt quit all thoughts of *Philoſophy*; or can at beſt expect but very ſlender Advantage from it. There were ſwarms of Opinions among the ancient Philoſophers; *Pythagoras*, *Philolaus*, *Xenophanes*, *Heraclitus*, *Empedocles*, *Parmenides*, *Anaxagoras*, *Leucippus*, *Democritus*, *Plato*, *Ariſtotle*, *Theophraſtus*, *Zeno*, &c. who all of them raiſed *Hypotheſes* at pleaſure, as ſo many *Fables of Worlds*; and propagated and publiſhed them, ſome with more and ſome with leſs Elegance and Probability [b]. But in our Age the Genius's of Men are more confined, by the founding of Schools and Colleges; yet *Patricius*, *Teleſius*, *Brunus*, *Severinus*, *Gilbert* and *Campanella*, have trod the Stage, and acted new Parts; tho with little Applauſe, and little Choice of Subject [c]. And in this way there might infinite *Opinions* and *Sects* ariſe in all Ages: nor is there yet, or ever will be, an End or Meaſure obſerved in this matter. One lays hold of this, another of that; different Men delight in different things: there is no *dry and pure Light amongſt Mankind*; but every one philoſophizes out of the narrow Cells of his own Imagination; the ſublime Genius's, with more Sagacity and Felicity; and the ordinary ſort, with leſs Succeſs, tho no leſs Obſtinacy [d].

The Confinement of the Sciences.

4. But of late, by the Doctrine of certain learned Men, join'd perhaps with ſome diſlike of the former licentiouſneſs, and difference, in Opinions, the *Sciences* are confined to a *few particular Authors* [e]; and in this Confinement impoſe upon the Old, and prejudice the Young: inſomuch that every thing is tranſacted as 'twere by an *Edict*; and *Authority* goes for *Truth*, not *Truth* for *Authority*. This kind of Diſcipline, however uſeful it may be for the preſent, yet certainly excludes, and baniſhes, much better things. Indeed we all experience and imitate the Sin of our firſt Parents; they *would be as Gods:* but we go farther, for *we will be creating new Worlds*, ever going before and lording it over Nature; and would have all things be *as ſeems beſt to our own Folly*, not to the *divine Wiſdom*, or as they *are in Nature* [f]. And

[b] The Author's Deſign has a Tendency to make all Men of one Opinion; by bringing them all to the Standard of Nature, which is ever one and the ſame: for different Opinions in *Philoſophy* only proceed from our Ignorance of Nature, or a want of knowing how things really are in themſelves.

[c] *Des Cartes*, ſince theſe, had greater Succeſs, and made all *Europe* fond of a *Philoſophy* that now begins to be deſpiſed, and treated as a Dream: and this, 'tis probable, will ever be the Caſe with *falſe Philoſophies*; which are no better than *Viſions*, that pleaſe for a time, but either vaniſh at the approach of Truth, or elſe give way to new Succeſſions of Fiction and Illuſion.

[d] It ſhould ſeem that very few uſeful Diſcoveries have been made in *Philoſophy*, but by the *Method of Induction*: at leaſt, it is evident that Mr. *Boyle* and Sir *Iſaac Newton* proceeded in that *Method*; as more fully appears in the *Notes* upon the *Novum Organum*.

[e] Suppoſe *Ariſtotle* and his *Commentators* in *Philoſophy*, and thoſe we call the *Claſſicks* in the *Humanities*.

[f] It were much to be wiſhed this juſt Cenſure might have its juſt Weight; and incline us to ſearch prudently into the *Wiſdom of the Creation*, without fondly imagining it is to be found at the

And 'tis a Queſtion, whether we diſtort Things or our own Minds the moſt; but we certainly ſtamp the *Seal of our own Image* upon the Creatures and Works of God, inſtead of carefully inſpecting and acknowledging the *Seals of the Creator:* whence 'tis but juſt, that we are again fallen from our *Empire over the Creation.* And thus, tho, after the firſt Fall, Man had ſtill ſome Dominion left him over the rebellious Creatures; ſo as by true and ſolid *Arts* to ſubdue and bend them to his Purpoſe; yet, by our Pride, and Deſire of being *like God*, and following the Dictates of our own *Reaſon* [g], we have in great meaſure loſt it. Therefore, if we have any Humility towards the Creator; if we have any Reverence and Eſteem of his Works; if we have any Charity towards Men, or any Deſire of relieving their Miſeries and Neceſſities; if we have any Love for natural Truths; any Averſion to Darkneſs; and any Deſire of purifying the Underſtanding; Mankind are to be moſt affectionately intreated, and beſeeched, to lay aſide, at leaſt for a while, their *prepoſterous*, *fantaſtick* and *hypothetical Philoſophies*, (which have *led Experience captive*, and childiſhly triumphed over the Works of *God* [h];) and now at length, condeſcend, with due Submiſſion and Veneration, to approach and peruſe the *Volume of the Creation*; dwell ſome time upon it; and, bringing to the Work a Mind well purged of Opinions, Idols and falſe Notions, converſe familiarly therein. This Volume is the *Language* which has gone out to *all the Ends of the Earth*, unaffected by the confuſion of *Babel*; this is the Language that Men ſhould throughly learn, and not diſdain to have its Alphabet perpetually in their Hands: and in the Interpretation of this *Language* they ſhould ſpare no Pains; but ſtrenuouſly proceed, perſevere and dwell upon it to the laſt [i].

5. To promote this capital End we are willing to leave, for the preſent, many principal Parts of our *Novum Organum*, or *new Logick*, unfiniſhed; as chuſing to ſet on foot, and promote, *all the Parts of our* INSTAURATION, rather than to perfect a few of them; with this ardent and conſtant Deſire, that what was never attempted before, may not now be attempted in vain [k]. We have alſo conſidered, that tho doubtleſs there are ſpread

The Author's Reaſons for leaving the Novum Organum *unfiniſhed, to purſue the* Hiſtory of Nature.

the Entrance of Things. For all that has hitherto been done in *Philoſophy*, notwithſtanding the modern Diſcoveries, is no more than the *Dawn* before *Day-light*.

[g] It is evident, that the Author here underſtands by *Reaſon*, that ſtrange Faculty we indulge of *reaſoning* about things, ſo as to ſquare and mould them to our own Fancy; inſtead of reaſoning juſtly from cloſe Obſervation and careful Experience, according to the Method delivered in the *Novum Organum*.

[h] The meaning is, that when *Phænomena are ſolved*, as 'tis called, by *Hypotheſis* and *Reaſoning*, without conſulting *Nature* and *Experience*, Men uſually applaud themſelves, as if they had made ſome wonderful Diſcovery, or had conquered Nature in certain Points; when at the ſame time ſhe is ſlipt thro' their Fingers; and the whole Proceſs has been no more than the ſport of Fancy: but the Remedy here is *Induction*. See *Novum Organum*, Part II. Sect. I. and II.

[i] Tho this may ſeem a kind of Repetition of what has already been touched upon in the *De Augmentis* and *Novum Organum*, it is not unſeaſonable here, at the Entrance of a *Hiſtory of Nature*; to ſhew what ought to be the primary View and Deſign thereof: eſpecially as the Mind is ſo extremely prone to quit the Drudgery of *Enquiry*, and ſlip into the facile Paths of *Fiction* and *Fancy*.

[k] It may ſeem ſtrange that no Philoſophers of former Ages, ſhould have gone upon the *direct Enquiry* into Nature, but all have turned aſide to *Theories*, *Hypotheſes* and *Opinions*; and yet,

ſpread over *Europe* great numbers of extenſive, free, ſublime, penetrating, ſolid and ſettled Genius's, ſome whereof may perceive, and perhaps approve, the *Scope* and *Uſe* of our *new Logick*, and yet not know how to proceed, and apply themſelves to real *Philoſophy* [l]. If the Buſineſs depended upon the reading of philoſophical Books, Diſpute, or force of Thought, they might be abundantly qualified for it; but as we refer them to the *Hiſtory of Nature*, and the *Experiments of Arts*, they may ſtick here, as at a thing unſuitable, or requiring too much *Time* and *Expence*; whilſt we cannot deſire any one ſhould quit his former *Knowledge*, before we put him in poſſeſſion of better. But after a faithful and copious *Hiſtory of Nature and Arts* ſhall be collected, digeſted, laid before, and opened to Mankind; there are hopes that ſuch great Genius's as thoſe above-mentioned, who both in ancient and later Times have been ſo ready and expert, as by wonderful Artifice and Workmanſhip to build *Syſtems of Philoſophy from the pooreſt Materials*; will not fail to raiſe more ſolid Structures, when poſſeſſed of good and ſound Materials for the Purpoſe: and this tho they ſhould chuſe to proceed in the old Way, rather than in that laid down by our *new Logick*; which appears to us either the only one, or the beſt for the Purpoſe [m]. So that upon the whole, tho our *new Logick* were perfected, yet could it not greatly promote the Re-eſtabliſhment of the *Sciences*; without the *Natural Hiſtory* we ſpeak of: whilſt this *Natural Hiſtory* may greatly promote the ſame End, without the Aſſiſtance of our *new Logick*. And therefore we judge it moſt adviſeable, firſt, and above all things, to endeavour at procuring this *Hiſtory*.

This Hiſtory of large extent.

6. But the *Hiſtory* we conceive in our Mind, is a thing of large Extent, and not to be procured without great Labour and Expence; as requiring the aſſiſtance of numerous Hands; and being rather the work of a *Prince* and a *People*, than of a *private Perſon*. And tho we might perhaps of ourſelves be able to perform what appertains to the *Conduct of the Underſtanding* [n]; yet the *Materials of the Underſtanding* are ſo diffuſive, that they require to be every where collected and imported to us, as it were by Factors and

yet, for any thing extant to the contrary, this appears to have been the caſe, among the *Greeks* eſpecially; except a few faint Attempts. Tho perhaps, the ancient *Egyptians*, the *Chaldeans* and the *Chineſe*, followed Nature cloſer than the *Greeks*. But the *Chineſe Philoſophy* was very imperfectly known at the time of our Author: the moſt of what we know of it to this day, in *Europe*, being handed to us by the late Jeſuit *Miſſionaries*.

[l] The Author was well aware of the Difficulty there would be to bring Men into the right Uſe of his *new Logick*; he ſuſpected that only the more Intelligent would thoroughly underſtand it: and the more Intelligent generally abound in *Schemes* and *Methods* of their own, which they are apt to prefer to thoſe of others. But ſince the moſt ſucceſsful Philoſophers among the Moderns, as particularly Mr. *Boyle*, Dr. *Hook*, Mr. *Locke*, and Sir *Iſaac Newton*, have, in ſome degree, followed the Method of *Induction*, and by that Means made conſiderable Diſcoveries; it is to be hoped Poſterity will rather follow ſuch eminent Examples, than truſt to any other Methods; which, tho more pompous and ſhewy, and, in appearance, expeditious, have, upon Trial and Experience, been rejected as deceitful and erroneous.

[m] If ſuch a *Hiſtory of Nature*, as the Author here deſcribes, were procured, Men of common Capacities might then make new Diſcoveries with tolerable Eaſe and Facility; ſomewhat like thoſe of Sir *Iſaac Newton*, when the neceſſary *Facts*, *Obſervations* and *Experiments* lay before him.

[n] That is to the finiſhing of the *Novum Organum*. See that Piece, *Part* II. *Sect.* II. *ad finem*.

and Merchants [o]. To this we add, that 'tis treſpaſſing too much upon ourſelves, to beſtow our own particular Time and Labour in a matter that lies open to the induſtry of all Men: but for the principal part of the Buſineſs, we will now ſet about it; and, with diligence and exactneſs, propoſe the manner and Platform of ſuch a *Hiſtory*, as may anſwer our Deſign: leſt Mankind, remaining unadvertiſed, ſhou'd deviate from the Purpoſe, conform themſelves to the Examples of the *Natural Hiſtories already extant*, and wander wide of our Intention. And what we have often ſaid, muſt here again be ſtrongly repeated; *viz.* that *tho the Genius's of all Ages ſhould have united, or ſhall hereafter unite, together; tho the entire Race of Mankind ſhou'd have addicted, or ſhall addict, themſelves to Philoſophy; tho the whole habitable World were nothing but Univerſities, Societies, Colleges, and Schools of learned Men; yet without ſuch* a natural and experimental Hiſtory *as we have now in view, there neither cou'd have been, nor can be, any progreſs made in Philoſophy, and the Sciences, worthy of Mankind.* On the other hand, when ſuch a *Hiſtory* is procured, and duly furniſhed, with the addition of ſuch auxiliary and leading *Experiments*, as either occur, or ſhall be ſtruck out in the courſe of *Interpretation*; the Enquiry into *Nature*, and *all the Sciences*, will be but the work of a few Years: And therefore this *Hiſtory* muſt either be procured, or the Buſineſs be deſerted. For by this means alone can the Foundations of a true and active *Philoſophy* be laid; and Mankind be made to ſee, as if waked from a Dream, what a difference there is between the Opinions and Fictions of the Brain, and real *effective Philoſophy*; and again, what, at length, it is to *conſult Nature about the things of Nature* [p]. We will therefore in the firſt place, lay down certain *general Precepts or Rules for compiling a Hiſtory* of this kind; and afterwards ſet a *particular Example* or *Pattern* thereof before the Eyes of Mankind; pointing out, as we proceed, thoſe things whereto the *Enquiry* ſhould be adapted, and referred, as well as thoſe to be ſought after; that the whole ſcope of the matter being well underſtood and foreſeen, other particulars may be brought to the Minds of others, that had eſcap'd ourſelves: and to this HISTORY, we give the name of PRIMARY or MOTHER-HISTORY [q].

A

[o] Theſe Materials are now imported to *England*, and other Countries, in conſiderable Plenty; and a kind of Traffick, in Learning and Knowledge, ſettled by means of the *Philoſophical Tranſactions*, the *French Memoirs*, the *Acta Eruditorum*, the *German Ephemerides*, and great numbers of *foreign Journals*, of late publiſhed, and ſtill continued, in *Holland*, *France*, *Germany*, *Italy*, &c. ſo that if Men were ſufficiently diſpoſed to improve this *Hiſtory*, it might ſoon be finiſhed, to that degree of Perfection the Author ſeems to have intended.

[p] The truth and juſtneſs of this Paragraph will appear to thoſe who conſider the Thing; or have read what is before delivered upon the ſubject of a NATURAL HISTORY, in the *de Augmentis* & *Novum Organum*. And certainly there can be no ſuch thing as a *ſerviceable and univerſal Philoſophy*, without a copious and extenſive *Hiſtory of Nature and Arts*, which are the very matter of ſuch a *Philoſophy*; that when duly ranged, explained, deduced, or, as the *Author* terms it, *interpreted*, and then form'd into *Axioms*, or *ſhort Directions* for future Uſe, will ſeem brought to the utmoſt Perfection requiſite or poſſible for Mankind.

[q] If the Reader will bear in Mind this Scope and Deſign of the Author, he may form the truer Judgment of the *Sylva Sylvarum*; which appears, for want of a proper Attention, to have been much undervalued. See the *Note* upon *Aphoriſm* II. below.

A Set of APHORISMS *for compiling a juſt* HISTORY OF NATURE AND ART.

APHORISM I.

That this Hiſtory be not wrote in too ſtrict a Method.

7. NATURE appears in three States, or under three kinds of Regulation: For (1.) She is either free, and proceeds in her ordinary Courſe; or (2.) is forced out of it by the depravity and intractability of Matter, and the violence of Impediments; or elſe (3.) She is bound and wrought by Art and human Adminiſtration. The *firſt* State regards the production of all *Species*; the *ſecond* the production of *Monſters*; and the *third* the production of *artificial Things*. For in *things Artificial*, Nature takes the ply from the over-ruling of Mankind; as they wou'd never have been produced without human Aſſiſtance: but by the labour and interpoſition of Man, there appears a perfectly new Face of Bodies; and as 'twere another Univerſe or Scene of Things[r]. *Natural Hiſtory*, therefore, is of three Kinds, and treats (1.) of the *Freedom*, (2.) the *Errors*, and, (3.) the *Bonds of Nature*; whence it may juſtly be divided into the *Hiſtory of Generations*, *Pretergenerations* and *Arts*; the latter whereof we alſo call *mechanical and experimental Hiſtory*[s]. But we do not direct that theſe three ſhou'd be treated apart; for the *Hiſtories of Monſters*, in each Species, may very well be join'd with the *Hiſtory of the Species*, or Bodies, themſelves. Sometimes alſo, *things Artificial* may be properly join'd along with *Species*; and ſometimes 'tis better to ſeparate them: whence 'tis very adviſable to conſider of their Conjunction or Separation occaſionally; for too *ſtrict a Method*, and no Method at all, equally occaſion *Repetitions* and *Prolixity*[t].

APHORISM II.

The End of this Hiſtory to be for Induction.

8. *Natural Hiſtory* has two Uſes; the one with reſpect to the things themſelves that are committed to Hiſtory; the other with reſpect to *the firſt matter of Philoſophy*; or the Proviſion and Apparatus of a *true Induction*: the latter is the thing we now intend; and was never intended before. For neither *Ariſtotle*, *Theophraſtus*, *Dioſcorides*, nor *Pliny*, much leſs the Moderns, ever propoſed to themſelves this End of *Natural Hiſtory*. And yet it is of the utmoſt Importance, that whoever ſhall hereafter undertake to write any Portion of *Natural Hiſtory*, ſhou'd determine not to ſtudy *the pleaſure of the Reader*, nor even *immediate Uſefulneſs* itſelf; but every where to *hunt up, and collect together a quantity and variety of matters, to ſerve for the forming of true Axioms*: and if they take but this into Conſideration, it will of itſelf direct

[r] See Mr. *Boyle*'s Eſſays upon the Uſefulneſs of *Natural Philoſophy*.

[s] See *de Augment. Scientiar.* Sect. I. *of Hiſtory*.

[t] The Reader will find this *Aphoriſm*, and all the reſt, exemplified by the Author, in his own *Specimen of a Hiſtory of Nature*, or the *Sylva Sylvarum* now preſently to follow.

direct the Means of procuring the *Hiſtory* we propoſe; for 'tis the *End* that governs the *Means* [u].

APHORISM III.

9. AND as this is a Work of much Pains and Labour, the leſs ſhou'd it be burden'd with things ſuperfluous. Men are therefore to be well advertiſed of *three Particulars*; that they may not miſemploy their Time, in what might ſwell the bulk of the Work, without adding to its Merit. (1.) The firſt Particular is, that all Antiquities, Quotations, and Authorities of Authors, be laid aſide; all Conteſts, Controverſies, and contrary Opinions; together with all philological Ornaments: and let no Author be cited, but in doubtful Caſes; nor Controverſy mention'd, but in Subjects of great Conſequence: and as for embelliſhment of Style, metaphorical Expreſſions, and ſtudied Eloquence, with the like lighter Matters, they ſhould be wholly rejected. And let whatever is received, be delivered cloſely and conciſely; that words may have the leaſt ſhare in it [w]. For no one who collects, and lays up, materials for a Building, places them beautifully for Shew, as in a Shop; but is only ſollicitous that they be ſound and good, and poſſeſs not too much room in the Store-houſe: and this *Example* ſhould be carefully followed, in compiling our intended Hiſtory.

Its Bulk to be contracted. (1.) *By omitting all foreign Ornaments.*

10. (2.) The common luxuriancy of *Natural Hiſtories*, running out into numerous Deſcriptions, Characters and Figures of *Species*, and their curious variety, makes little to the purpoſe; ſuch ſmall variations being but the ſport and wantonneſs of Nature, and near approaches to the Individuals: ſo that tho there may be a beautiful and agreeable deviation in the things themſelves, yet this affords but a ſlender, and almoſt needleſs, Information, to the improvement of the *Sciences*.

(2.) *Deſcriptions of light Curioſities.*

11. (3.) All *ſuperſtitious Relations*, and the Experiments of ceremonial Magick, are entirely to be dropt; tho without abſolutely excluding *Things prodigious*; where the account of them is probable, and worthy of Credit: for the Infancy of Philoſophy, which is nurſed by Natural Hiſtory, ſhould not

And (3.) *ſuperſtitious Relations.*

[u] Many Perſons, not attending to this *End* of the *Sylva Sylvarum*, have treated it as a kind of *Rhapſody*, or *trifling Collection* of *Rumors* and *Relations*; without at all diſcerning the Drift and Tendency thereof; or entring into the Deſign and View of the Author. Such a miſconſtruction of ſo capital a Work, undertaken with ſuch great Labour, Thought, and Judgment, muſt needs be very diſcouraging to thoſe who wou'd follow its Steps; eſpecially, when this kind of miſconſtruction is found in Men eminent for Learning. And yet, unleſs this plain and homely Method be purſued, in procuring a *Hiſtory of Nature*; Mankind muſt ſtill be left to ſtruggle with Difficulties, and grovel in Darkneſs. It ſhou'd therefore be obſerved, for the Encouragement and Benefit of others, that learned Men, or thoſe who commonly paſs for ſuch, may be very little qualified to judge of *Philoſophical Performances*; or for diſcovering the excellency of thoſe things, which, tho extenſively uſeful, are not dreſs'd out with Philological Ornaments, or other Embelliſhments, really foreign, and prejudicial, to the *Inveſtigation of Truth*.

[w] The Buſineſs is not now to gain upon Men's Affections, or win them over to *Philoſophy*, by Eloquence, Similitudes, or the Art of Writing; which the Author practiſed in the *de Augmentis*; but carefully to enquire into, and juſtly to copy, and deſcribe, Nature, as ſhe is in herſelf: and here the Style cannot well be too plain and ſimple.

be fed with *Fables*. There may, perhaps, come a time (when a farther Progreſs ſhall be made in the Enquiry into Nature) for touching theſe things lightly; to try if any *natural Powers* cleave to ſuch Dregs, and can be ſeparated from them for Uſe; but in the mean time they muſt be ſet aſide. The *Experiments*, likewiſe, of *Natural Magick* are to be carefully ſifted, before they are received; particularly thoſe which Sloth, and Credulity, have admitted, and improved, from the vulgar *Sympathies* and *Antipathies*.

The Example of a Builder to be followed in the Compilement.

12. And no ſmall Point will be gain'd, by thus diſburdening *Natural Hiſtory* of theſe *three ſuperfluous Things*, which might otherwiſe fill whole Volumes. Nor is this all; for *large Works* require that the things received into them, ſhould as well be conciſely wrote, as ſuperfluities omitted; tho, doubtleſs, this ſtrictneſs and brevity will afford leſs Pleaſure, both to the Writer and the Reader: but it muſt always be remembred, that the Point of View here, is to procure and furniſh a *Store-room* or *Repoſitory*; not a Houſe to dwell in for Pleaſure; but to enter into upon occaſion, as any thing is required for Uſe, in the *buſineſs of Interpretation* that is to ſucceed [x].

APHORISM IV.

This Hiſtory to be made Univerſal; and to contain,

13. IT is alſo a capital thing in this our intended *Hiſtory*, that it be *extenſive*, and made to the *meaſure of the Univerſe*; for the World is not to be ſqueez'd up to the narrowneſs of our Underſtanding, as it hitherto has been; but the Underſtanding is to be dilated, to receive the Image of the World, as we find it: for to regard only a few *Phænomena*, and to pronounce according to them, is the bane of Philoſophy [y].

(1.) The Hiſtory of Generations, conſiſting of five Parts.

14. To proceed, therefore, with our diviſion of *Natural Hiſtory* into *Generations*, *Pretergenerations*, and *Arts*; we make the *Hiſtory of Generations* to conſiſt of *five Parts*; viz. (1.) The *Hiſtory of the Æther, and celeſtial Bodies*; (2.) The *Hiſtory of Meteors, and the Regions of the Air*; or all that ſpace betwixt the Moon and the Surface of the Earth; including alſo, for the ſake of Order, *the Comets, both higher and lower*; (3.) The *Hiſtory of the Earth and Sea*; (4.) The *Hiſtory of the Elements*, as they are call'd, or *Fire, Air, Earth, and Water*; taking the Elements not for primordial Matters, but *larger Maſſes* of natural Bodies. For the nature of things is ſo laid out, as to form a very large quantity, or *maſs*, of certain Bodies in the Univerſe; where an eaſy and looſe texture of Matter is required to their Structure, as in theſe *four Elements*; whilſt there is but a proportionably ſmall quantity of certain other Bodies in the Univerſe; thus ſparingly ſupplied, by reaſon of a very diſſimilar and ſubtile Texture of the Matter, here made Organical;

[x] The Author's *inductive Hiſtories* of *Life and Death, Winds, Rarity* and *Denſity*, are Inſtances of the uſe to be made of this general *Hiſtory of Nature* and *Experiments*. But this matter has been already ſufficiently clear'd up in the *Novum Organum*. See *Part* II. of that Work.

[y] And, in reality, a weakneſs, or ſpecies of Folly. See the *firſt Part* of the *Novum Organum*.

ganical; and determined in many Particulars [z]; as in the *Species* of natural Bodies; Minerals, Plants, and Animals: whence we call the former kind, *larger Aſſemblages*; and the latter, leſſer *Aſſemblages* of Matter. And theſe *larger Aſſemblages* make the *fourth part* of our Hiſtory. Nor do we here confound the *fourth Part* with the *ſecond* or *third*; by having mentioned *Air*, *Water* and *Earth* in each of them; becauſe in the *ſecond* and *third*, their *Hiſtory* is meant of the integral Parts of the World; and as they relate to the Structure and Configuration of the *Univerſe:* whilſt the *fourth* contains the *Hiſtory* of their Subſtance, and Nature, which prevails in each ſimilar part thereof, without regard to the whole. (5.) And Laſtly, the *fifth part* of our *Hiſtory* contains the *leſſer Aſſemblages*, or *particular Species* of Bodies; about which alone all *Natural Hiſtory* has hitherto been principally employ'd.

15. The *Hiſtory of Pretergenerations*, we before obſerved, may be very commodiouſly joined with the *Hiſtory of Generations*; ſo far as 'tis only *prodigious*, yet natural [a]; referring the *ſuperſtitious Hiſtory of Miracles*, of all kinds, to a *peculiar Treatiſe* by themſelves: tho this is not to be undertaken immediately, at the entrance; but after ſome farther Progreſs is made in the *Enquiry of Nature*. (2.) *The Hiſtory of Pretergenerations.*

16. The *Hiſtory of Arts*, and *Nature faſhioned* and *changed* by human means, we divide into three Parts; as 'tis drawn either, (1.) from the mechanick Arts; (2.) from the effective part of the liberal Sciences; or, (3.) from the numerous Practices and Experiments which are not yet formed into proper Arts; or which ſometimes turn up in vulgar Experience, and require no Art at all. So that if a *Hiſtory* were compiled of *Generations*, *Pretergenerations*, *Arts*, and *Experiments*, there ſeems to be nothing omitted for enabling the Senſes to inform the Underſtanding [b]: and thus we ſhould no longer friſk about, as it were, in little enchanted Circles; but encompaſs the whole extent and circumference of the World. *And* (3.) *the Hiſtory of Arts.*

APHORISM V.

17. AMong the ſeveral Parts of this *Hiſtory*, that of *Arts* is the moſt uſeful; as it ſhews things in Motion, and leads more directly to Practice. It likewiſe unveils, and takes off the Maſk from, natural Things; which are generally concealed, and darkened, under a variety of Forms, and external Appearances. Again, the *Tortures of Art* are like the Bonds and Shackles of *Proteus*, which diſcover the ultimate Attempts and Endeavours of Matter: for Bodies will not be deſtroyed, or annihilated, but rather change themſelves into various Shapes; and therefore the greater Care *A more particular regard to be had to the* Hiſtory of Arts.

[z] The Author here intimates the *phyſical Reaſon*, why there are more of ſome Bodies in the Univerſe than of others; a thing ſet down as deficient in the *de Augmentis Scientiarum*; under the Doctrine of *Tranſcendentals*. See that Work, *Sect.* III. 4.

[a] See above, *Aphoriſm* II.

[b] With this view the Author ſeems to have drawn up the *Catalogue of particular Hiſtories*, in the following *Section*.

and Diligence is to be uſed in preparing this *Hiſtory*; tho it may ſeem to ſome but a *mechanical* and *illiberal* thing [c].

And among them, chiefly to thoſe that change and prepare natural Bodies.

18. Among *Arts*, thoſe are to be preter'd which *treat*, *alter*, and *prepare*, *natural Bodies* and Materials; as *Agriculture*, *Cookery*, *Chemiſtry*, *Dying*, the *Art of Glaſs*, *Enamelling*, *Sugar-baking*, *Powder-making*, *artificial Fire-works*, the *Art of Paper*, &c. But thoſe are of leſs ſubſtantial Uſe, which principally conſiſt in the ſubtile Motion of the Hand and Inſtruments; as Weaving, Carpentry, Building, the Art of Mills, Clock-making, *&c.* tho theſe alſo ſhould by no means be neglected; becauſe many things occur in them, which regard the Alterations of natural Bodies: and again, becauſe they give an exact Information of the *Motion* of *Tranſpoſition*; which is a thing of great moment in many reſpects.

The collecting of eminent Inſtances in Arts, to be more regarded than the perfecting of Arts themſelves.

19. This Admonition muſt be well remembered thro' the Whole; that *not only ſuch Experiments of Arts* ſhould be received as lead to the End of the Art; but thoſe alſo which any way turn up in it. Thus, for Example, tho it makes nothing for the Table, that the duſky Colour of Crabs and Lobſters changes to red in boiling; yet this is no improper Inſtance in the Enquiry into the Nature of Redneſs; as the ſame thing likewiſe happens in the burning of Bricks. So again, that Meat ſooner takes Salt in Winter than in Summer, ſerves not only to direct the Cook in his ſeaſoning of it; but is alſo a good Inſtance for indicating the Nature and Impreſſion of Cold. And therefore he will abſolutely miſtake our Purpoſe, who thinks to anſwer it by collecting the Experiments of Arts, to this End only, that each Art may by ſuch means be perfected the better: for altho we do not entirely deſpiſe ſuch a Procedure, in many Caſes; yet our direct Intention is *to turn the Rivers of mechanical Experiments, from every Quarter, into the Ocean of Philoſophy* [d]. And the choice of *eminent Inſtances* in each kind, which ought principally, and with the utmoſt Diligence, to be ſearched out, and hunted up, muſt be derived from the Doctrine or Knowledge of *prerogative Inſtances* [e].

APHORISM VI.

That common and mean Matters be received into this Hiſtory.

20. WE muſt next briefly repeat, in the way of *Precept*, what is more largely diſcuſſed in our *new Logick* [f], viz. That, *firſt*, the commoneſt things be received into this Hiſtory; and ſuch as being familiarly known

[c] All the Objections that might be made to ſuch a Hiſtory, ſeem ſufficiently obviated in the *Novum Organum*, Part I. Sect. VII. 3, 4, 5, 6, 7, 8, *&c.*

[d] The utmoſt addreſs ſeems requiſite to convince Mankind of the nobleneſs and great utility of this Deſign. There is a ſtrange Reluctance, and a kind of Loathing in the Mind, with regard to *mechanical Experience*, and the homely Obſervations of the *Kitchen*, the *Dairy*, the *Cellar*, ſervile Arts, and the like: and yet the moſt neceſſary, and ſerviceable part of all *Natural Philoſophy*, muſt be derived from ſuch Obſervations. And they who deſpiſe Nature in theſe lower Works, muſt expect that Nature will deſpiſe them; or not admit them into her ſecret Operations. To give a ſingle Inſtance; is not a juſt Knowledge of *Fermentation*, in its *Theory* and *Practice*, a greater Enrichment to Natural Philoſophy, and of more immediate Service in Life, than the Doctrine of Curves; or the making of Gold?

[e] See this fully explained in the ſecond Part of the *Novum Organum*, Sect. II. where the important *Doctrine of Inſtances* is largely proſecuted.

[f] See *Part* I. *Sect.* VII. 3, 4, 5, 6, *&c.*

known might ſeem unneceſſarily committed to Writing: *ſecondly*, even ignoble, illiberal and trivial Matters; for Light and Information muſt be ſought from every Quarter; and Men in this caſe are again to become Children: and, *thirdly*, that ſuch things muſt alſo be here received, as ſeem of too great Subtilty to be in themſelves of any Uſe: for the Matters to be collected in ſuch a Hiſtory, are not, as we before obſerved, collected for their own ſakes; and therefore their Dignity is not to be meaſured by itſelf: but according to their ſuitableneſs for entring the Body of Philoſophy [g].

APHORISM VII.

21. LET it be another *Rule*, that *every thing, as well in the Bodies themſelves, as their Powers, be, as much as poſſible, delivered in Number, Weight, Meaſure and Proportion*; for we intend not Speculations, but Works: and it is a ſuitable Mixture of *Phyſicks* and *Mathematicks*, that produces Practice. And therefore the exact *Revolutions*, and Diſtances, of the Planets, are to come in the *Hiſtory of the heavenly Bodies*; the Circumference of the Earth, and the Proportion of its Surface, with regard to that of the Water, in the *Hiſtory of the Earth and Sea*; what degree of Compreſſion the Air will ſuſtain, without a ſtrong Reluctance, in the *Hiſtory of the Air*; the relative ſpecifick Gravities of one Metal in reſpect of another, in the *Hiſtory of Metals*; with numerous Particulars of like kind; which are to be carefully ſearched out and noted [h]. But when exact Proportions cannot be had, we muſt take up with Eſtimation, or indeterminate Compariſon: as for example, if we diſtruſt the aſtronomical Calculation of Diſtances, we muſt be content to ſay, that Mercury is above the Moon, *&c.* So again, when mean Proportions cannot be had, let the Extremes be given: as, for example, that a weak Loadſtone raiſes ſuch a weight of Iron, in reſpect of the Stone, and the ſtrongeſt ſixty times its own weight; as I have ſeen in a very ſmall armed Magnet. But we are aware, that theſe *determinate Inſtances* do not eaſily, or frequently occur; tho they ought to be endeavoured after, as Auxiliaries, when the Matter greatly requires them, thro' the courſe of *Interpretation*. However, if they happen to occur, they ought to be inſerted; provided they do not too much retard the Progreſs of the *Hiſtory* [i].

That the Proportions of Powers, Magnitudes, and Diſtances, be noted.

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[g] Let no one, therefore, be raſh in cenſuring the Author's *Sylva Sylvarum*; which, when well underſtood, ſeems pregnant with the *proper Matter* for a *General Hiſtory of Nature and Experience*; that ſerves as the Baſis of inductive Hiſtory, and ſolid *univerſal Philoſophy*. Certainly, none but thoſe of large and comprehenſive Views, or Men well verſed in *Nature* and *Experience*, ſhould judge of ſuch a Performance. See the *Note* upon *Aphoriſm* II. above.

[h] The Excellence of the modern *Mathematical Philoſophy*, is perhaps in nothing more conſpicuous, than a careful obſervance of this uſeful Rule. Nor were it poſſible to predict *Eclipſes* to that Preciſeneſs we do at preſent, without a tolerably exact knowledge of the Orbits, the relative Magnitudes and Diſtances of the celeſtial Bodies: which have been diſcovered by repeated Obſervation, and brought into Tables.

[i] The determining of theſe abſolute and relative Proportions of Powers, Magnitudes and Diſtances, ſeems the principal Uſe of Mathematicks in Philoſophy; and that whereto it ſhould be chiefly confined; for Magnitude, or Quantity, is the proper Object of Mathematicks: but when

APHORISM VIII.

In what manner the ſeveral kinds of Matters are to be admitted into this Hiſtory.

22. AS to the *Authority of the Matters to be received into this Hiſtory*, it muſt of neceſſity be either *good*, *doubtful*, or *bad*: the *firſt* kind is to be propoſed naked; the *ſecond* with a Mark affixed; or with an *It is ſaid: I was told by a Perſon of Credit*, &c. for it would be too tedious, and delay the Writer too much, to ſet down the Arguments for and againſt the credibility of what he delivers: nor would this greatly avail to the Buſineſs in hand; becauſe, as we formerly obſerved [k], the Truth of *Axioms* will ſoon after prove the Falſity of Experiments, unleſs ſuch falſe Experiments ſhould ſuper-abound. But if the Inſtance ſhould be a noble one, either for Uſe, or becauſe much may depend upon it; then the Author muſt by all means be mentioned: and that not barely, but with ſome notice, whether he took it from Report, or tranſcribed it, as *Pliny* generally did; or whether he affirms it of his own knowledge; whether it were of his own, or a more ancient, time; whether of that nature as to require many Witneſſes of its truth; or, laſtly, whether the Author were ſolid and ſober, or vain and light; with the like Particulars, which regulate the force of Authority [l]. In the *third* place, Matters of no Credibility, tho yet current and famous; ſuch as partly thro neglect, partly thro the uſe of Metaphors, have prevailed in many Ages; as, that the Diamond tyes down the Loadſtone, *&c.* are not to be rejected by Silence; but thrown out by expreſs Words, that they may no longer moleſt the *Sciences*.

To note, occaſionally, Vanities and Credulities.

23. It might likewiſe be proper to note, by the way, the Origin of particular *Vanities* and *Credulities*: ſuch, for inſtance, as that a Power of exciting Venery is attributed to the Plant *Satyrium*, only becauſe its Root is formed after the manner of Teſticles: whilſt the Truth only is, that a new bulbous Root grows, every Year, to the Root of the former Year; and thus makes two: as appears from hence, that the new Root is always found ſolid and ſucculent; but the old one ſhrunk and ſpungy. Whence 'tis no wonder the one ſhould float, and the other ſink in Water: which yet has been held as a ſtrange thing; and given authority to the other ſuppoſed Virtues of this Plant.

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when this Science is applied to the ſolving of Phænomena, in the way of Accommodation, Hypotheſis, or Suppoſition; it then becomes imaginary and fantaſtical; and ſeems to act out of its Office, not to the Improvement, but Subverſion, of *Philoſophy*: as was remarkably the Caſe in *Aſtronomy*, before the ſtrict inductive Procedure of Sir *Iſaac Newton*.

[k] See the *Novum Organum*, Part I. Sect. VII. 3, *&c.*

[l] 'Tis very remarkable, that the Author himſelf, and Mr. *Boyle*, by carefully obſerving this Rule, have incurred the Cenſure of *Credulity*: a Cenſure that has ſtrangely ſpread over *Europe*; and been credulouſly entertained by Perſons unacquainted with the exact and ſcrupulous Procedure of theſe two illuſtrious Philoſophers. Nor is it an eaſy matter to recover their Characters in this reſpect; tho the Opinion itſelf is falſe and groundleſs. So little do the Bulk of Mankind diſtinguiſh, betwixt *original Report* and that at *Second-hand*, tho ever ſo cautiouſly guarded.

APHORISM IX.

24. THere remain certain uſeful *Appendages to Natural Hiſtory*, capable of fitting it more commodiouſly to the ſucceeding Buſineſs of the *Interpreter*: theſe are *Five* in Number. *Five Appendages to this Hiſtory.*

25. And, *Firſt*, Queries, not with regard to Cauſes, but Matters of Fact, are to be ſubjoined; to ſollicit and provoke farther *Enquiry*. As in the *Hiſtory of the Earth and Sea*; whether the *Caſpian* Sea ebbs and flows; and at what times? Whether there be any *ſouthern Continent*, or rather Iſlands? and the like. Viz. (1.) *Queries as to Facts.*

26. *Secondly*, In all new, and curious, *Experiments*, the manner uſed in making the *Experiment*, muſt be added; to leave the Judgment of Mankind free, whether the Information by the Experiment be juſt, or fallacious: as alſo to excite their Induſtry to invent, if poſſible, more exact Methods of Trial [m]. (2.) *The manner wherein Expements were made.*

27. *Thirdly*, If there ariſe any Doubt, or Scruple, in a Relation, it ſhould not be concealed, or ſuppreſſed; but clearly wrote down, in the way of *Note*, or *Admonition:* for we deſire this *primary Hiſtory* ſhould be compiled with the moſt religious and ſacred regard to Truth, in all Particulars; as being the *Volume of God's Works*; and, with due reverence to *divine Revelation*, a *ſecond Scripture.* (3.) *Notes and Admonitions.*

28. *Fourthly*, It will alſo be proper, after the manner of *Pliny*, ſometimes to interſperſe Obſervations; as in the *Hiſtory of the Earth and Sea*, for example, that the Figure of the *Earth*, ſo far as we hitherto know it, with reſpect to the Water, is narrow and pointed to the South; but wide and ſpreading to the North; directly contrary to the Figure of the Waters; and that the great *Oceans* cut the Lands in wide Channels between the North and South, not between the Eaſt and Weſt; unleſs perhaps in the Extremities of the polar Regions. *Canons*, alſo, which are no other than general and univerſal Obſervations, are juſtly ſet down; as in the *Hiſtory of the heavenly Bodies*, that *Venus* is never removed above forty-ſeven Degrees from the *Sun*; nor *Mercury* above twenty-eight: and that the Planets above the Sun move ſloweſt, when fartheſt from the Earth, and thoſe below the *Sun*, ſwifteſt [n]. (4.) *Obſervations, Canons, and Things that are, ſubjoin'd to thoſe that are not.*

29. Another kind of *Obſervation* muſt be likewiſe employed, as a thing of conſiderable moment, tho not hitherto in Uſe; *viz.* the *ſubjoining to things that are*, the *things which are not*; as in the *Hiſtory of the heavenly Bodies*, that there is no oblong or triangular Star; but that all Stars are either round, or gibbous, when ſhorn of their Rays; or that the Stars are placed irregularly, not in Squares, Pentagons, or other perfect Figure; and ſcarce any three of them in a right Line.

30. *Laſtly*,

[m] And thus Mr. *Boyle*, Dr. *Hook*, Sir *Iſaac Newton*, and many of the modern Philoſophers, have tried over again, verified, confirmed, and improved upon, ſeveral Experiments of the Author; as particularly thoſe of *Sounds*, the *Microſcope*, the *Thermometer*, the *Priſm*, &c.

[n] The Reader will find theſe *larger Obſervations* and *Canons* more frequently uſed in the Author's Specimens of *Inductive Hiſtory*, than in the *Sylva Sylvarum*. See particularly the *Hiſtory of Life and Death*; and the *Hiſtory of Winds*, *paſſim*.

(5.) *Received Opinions to be slightly touched.*

30. *Lastly*, It may be of some service to the *Enquirer*, tho a great prejudice to the *Believer*, to have the Opinions now received, briefly touch'd; together with their Varieties and Sects; and related only in passage, as a Hint to the Understanding, and no farther °.

APHORISM X.

The Work feasible.

31. AND so much for the *general Precepts for compiling our History of Nature and Experience*; which, if carefully observed, its End will be duly obtained, without swelling above measure. But if, as thus limited and circumscribed, it shall still appear a vast Work to any pusillanimous Spirit; let him cast his Eye upon *Libraries*; and, among other things, consider the Bodies of the *Civil* and *Canon Law*, on the one side; and the *Commentaries* of *Lawyers* and *Learned Men*, on the other; and see what a Difference there is between this and that, as to bulk and number of Volumes. For my own part, who desire nothing more than to be a faithful *Secretary to Nature*, and to receive and copy nothing but her Laws, I chuse Brevity; and find it in a manner imposed upon me, by the thing itself: but for Opinions, and Notions, and Speculations, they are without number, without end.

SECT. II.

Containing more precise DIRECTIONS, *and a Catalogue of the* PARTICULAR HISTORIES, *required to the* true Interpretation of Nature.

More particular Directions for such as would assist in compiling the History *above-mentioned.*

1. IT were now proper to sit upon the several *Heads of Histories*, and examine Nature, Article by Article, what Particulars in each *History* should be principally enquired into, and wrote down; as certain *Topicks*, directly conducing to the End above proposed: which would be to proceed in the Great Cause, wherein Mankind endeavour to recover their lost Right over the Creatures. But this is a Work of large extent; which, however, we propose, in some measure, to execute; by enquiring into several *Cardinal Virtues*, or *capital Powers* of *Nature*, in order to a just *Interpretation of her Works* [p]: since we cannot promise for the Industry of others, upon this Head; till Men shall have begun to cultivate a closer Acquaintance with Nature.

But

° And thus, for example, if the *History* were to be carefully continued, we should intimate, by the way, that the Doctrine of *Attraction* is frequently wrested, and injudiciously applied; that *mathematical Calculations* are abused in numerous Instances; and that false Imaginations are every where indulged, of the modern Discoveries; to the prejudice and slow advancement of *universal Philosophy*.

[p] This the Author proposed to prosecute, in several Sets of *particular* Enquiries, into capital Subjects; as the *History of Life and Death*, the *History of Winds*, the *History of Density* and *Rarity*,

But for more particular Directions, if any one ſhall deſire to aſſiſt us in this *Undertaking*, we will here annex the *preciſe Rules* we propoſe to follow in the Work.

2. And *firſt:* As it were endleſs to purſue all *Subjects*, we make choice of ſuch as are of greateſt importance for Uſe; moſt convenient for quantity of *Experiments*; more difficult, and noble, for their Depth and Obſcurity; or moſt exemplary, and extenſive, on account of their Richneſs, or difference of *Heads* or *Titles* [b]. *The Subjects to be choſe.*

3. In each Subject, after a ſhort *Introduction*, or *Preface*, we immediately lay down the particular *Topicks*, or *Heads of Enquiry*; as well to give light for the preſent, as to ſollicit a farther Search in future: for tho we are not Maſters of Things, yet we are Maſters of Queſtions. We do not, however, preciſely obſerve the order of *Queſtions*, in the *Hiſtory* itſelf; leſt what was intended for a Help ſhould prove a Hinderance [c]. *The Method of treating them.*

4. *Hiſtory* and *Experiments* always hold the firſt Place; which, if they exhibit an enumeration and ſeries of Particulars, are thrown into *Tables*; but otherwiſe are ſet down ſeparate. *Hiſtory and Experiments claim the firſt place.*

5. But as *Hiſtories* and *Experiments* are frequently wanting, eſpecially thoſe that give Light to the Enquiry, and would be *crucial Inſtances* [d]; by which alone the Underſtanding can be ſatisfied of the *true Cauſes of Things*; we direct the making of ſuch *new Experiments*, ſo far as we are able to foreſee, as appear proper to determine the Queſtion. And theſe Directions are the *Deſignations*, or *Intimations of Hiſtories*, which is all that we can offer; as ourſelves are now but juſt firſt entering the *Road of Hiſtory*. *When Experiments are wanting, to indicate them.*

6. When ſeveral *Experiments* fall under two or more *Titles*; as in the *Hiſtory of Plants*, and the *Hiſtory of Gardening*, where various Particulars are common to them both; we judge the *Enquiry* is better conducted, by regarding the Bodies; but the Diſpoſition by regarding the *Arts:* for we pay little regard to the *Arts themſelves* [e]; except ſuch as conduce to the *forming of Philoſophy*. But the Conduct in theſe Caſes will occaſionally be directed by the Things themſelves. *When Experiments come under ſeveral Heads, to regard the Matters, and not the Arts.*

Rarity; which were executed: but the *Hiſtories* of many other things; as thoſe of *Gravity* and *Levity*, *Sympathy* and *Antipathy*, *Salt*, *Sulphur* and *Mercury*, &c. were never publiſhed.

[b] Hence the Author has ſhewn great Judgment, in pitching upon the *Hiſtory of Life and Death:* as the Prolongation of Life, is not only an intricate and multifarious Enquiry; but of the utmoſt Importance to Mankind: and neceſſary in order to the Improvement of all other Arts and Sciences. And next to this, he cou'd not, perhaps, have made a better Choice, than in beginning the *Enquiry into Winds*; as the right management of this Power in Nature, might greatly conduce to eaſe the Labour of the Hand; procure Intelligence by Commerce; and lay the Foundation for many other natural Enquiries.

[c] Too rigid a Method, in ſuch Enquiries as cannot be fully proſecuted by any one Man, or any ſingle Age, is to be avoided: for *Matter* muſt ever direct *Method*. And we ſhou'd greatly miſtake the Deſign of the Author, to imagine he has finiſhed any ſingle Enquiry: all he endeavoured was but to begin them.

[d] What theſe *Inſtances* are, is fully explained in the *Novum Organum*, Part II.

[e] To regard Arts themſelves, would be making Philoſophy a Slave to preſent Advantage; which is a ſecondary Conſideration: and by diverting Philoſophy from its purpoſe, Arts themſelves would be Sufferers; for when Philoſophy is improved and carried to its due height, the improvement and perfection of all Arts, will follow of Conſequence. And this particular ought to be well regarded; otherwiſe, by catching at Shadows, we ſhall loſe the Subſtance.

To relate how the Experiments were made.

7. We explain the manner obſerved in making all ſubtile or more curious Experiments; to prevent Error, and excite others to contrive more exact, and better Methods, of verifying or confirming them.

To interpoſe Admonitions, Cautions, and Glances at the Interpretation of Nature.

8. We frequently interſperſe Admonitions and Cautions, with regard to the Fallacies of Things; and the Errors and Scruples that may occur in the Enquiry, or Diſcovery: in order, as much as poſſible, to charm down all Fancies and falſe Conceits. We likewiſe, all along, ſubjoin our *Obſervations* upon *Hiſtory* and *Experiments*; in order to promote, and prepare, the Buſineſs of *interpreting Nature*.

Hints at Cauſes.

9. We here and there interpoſe our Suſpicions, in the way of firſt Outlines, towards the Explanation of Cauſes; but ſo as rather to ſuggeſt what may be, than to determine what really is the Caſe.

10. We form, and ſet down, *Canons*, tho variable; or imperfect and improveable *Axioms*; which offer themſelves in the buſineſs of Enquiry: but this without determining: for ſuch *Canons*, or *Axioms*, may be uſeful, tho not preciſely true [f].

Hints for practical Uſes.

11. And tho Light be a nobler thing than the Objects it ſhews; yet being ever mindful of the Service of Mankind, we ſtart *Hints* of Practice, and recommend them to Men's Attention and Memory: as well knowing, that Mankind unfortunately labour under ſuch a great degree of inſenſibility, as ſometimes not to ſee, but ſtep over, things that lye before their Feet; unleſs put in mind thereof.

To ſet down Optatives; or things next to impoſſible.

12. We propoſe, under every Subject that allows it, even Works and *Things impoſſible*; at leaſt ſuch as are not hitherto diſcovered: and, at the ſame time, ſubjoin ſuch, as being already known, and within the Power of Man, nearly approach and reſemble thoſe Impoſſibilities, and undiſcovered Things; in order, at once, to encourage Mankind, and excite their Induſtry [g]. And thus we hope, not only to furniſh out, in ſome tolerable degree, the *third* Part of our INSTAURATION, but in good meaſure alſo to pave the way for the *fourth* and *ſixth* [h].

An Invitation for others to aſſiſt.

13. Theſe are the *particular Rules* I purpoſe to follow, in compiling what part I am able, of a ſound and ſerviceable *Natural* and *Experimental Hiſtory*: which, to proſecute in its full Extent, is, as we before obſerved, a Work too great for a ſingle Perſon; whence we earneſtly invite others to take part of the Task. For their better Direction, we will here indicate ſome of the *particular Hiſtories*, which appear to us proper to be gone upon; and ſubjoin a *Collection* of thoſe we eſteem the moſt important for the Uſes of Life.

A

[f] Duly to underſtand the Force and Uſe of theſe *particular Rules*, which the Author preſcribes himſelf, in compiling his *Hiſtory*, will give great Light into the Nature and Deſign of the *third*, *fourth*, and *ſixth Parts* of the Grand INSTAURATION.

[g] With what Judgment this Rule was form'd; with what Skill and Addreſs obſerved, by the Author; and to what great Advantage, few will perceive that are not *Inventors*.

[h] For the larger *Obſervations*, the *Canons*, and *Axioms*, that every where occur, were to be verified, render'd ſtrictly juſt and true, in the *fourth* Part of the *Inſtauration*, and then directly tranſferr'd into the *ſixth*; ſo that this laſt, capital Part of the whole, was to be form'd in the precedent *Parts*, and only drawn out in the *ſixth*; the place deſtined to receive that *pure, genuine and axiomatical Philoſophy, which ſhou'd flow ſpontaneouſly from the preceding rigid and ſevere Enquiry*.

A CATALOGUE *of* PARTICULAR HISTORIES, *required for the* INTERPRETATION *of* NATURE; *or laying the Foundations of* INDUCTIVE HISTORY.

1. *THE* History of the Heavenly Bodies; *or* Aſtronomical Hiſtory [a].
2. *The* Hiſtory of the Configuration of the Heavens, *and their Parts, to the Earth and its Parts; or the* Coſmographical Hiſtory [b].
3. *The* Hiſtory of Comets [c].
4. *The* Hiſtory of fiery Meteors [d].
5. *The* Hiſtory of Lightning, Thunder, *and* Corruſcations [e].
6. *The Hiſtory of Winds, ſudden Guſts and Undulations of the Air* [f].
7. *The Hiſtory of Rainbows* [g].
8. *The Hiſtory of Clouds, as they appear above* [h].
9. *The Hiſtory of the* blue Expanſe, *the Twilight, mock-Suns, mock-Moons, Halo's, the various Colours of the Sun and Moon, and of all the variety of appearances in the Heavenly Bodies, with regard to the Medium* [i].

[a] The Author himſelf begun this; in his *Eſſay toward a Philoſophical Hiſtory of the Heavens.* See the *ninth Supplement* to the *de Augumentis Scientiarum.* It has been continued by numerous Writers, tho not preciſely in his own manner. Among the principal are Meſſ. *Hevelius, Tacquet, de la Hire,* Sir *Iſaac Newton,* Mr. *Flamſtead,* Dr. *Gregory,* and Dr. *Halley.*

[b] The Deſign of this *Hiſtory* ſeems, in ſome degree, ſuperſeded, by the later Diſcoveries; which ſhew the *Configuration of the Heavens* to be *Optical,* or depending upon the Nature of *Viſion.* But the Author's meaning will be better underſtood, by his *Specimen* of *animated Aſtronomy.* See the *ninth Supplement* to the *de Augmentis Scientiarum.*

[c] The *Hiſtory of Comets* is largely proſecuted by *Lubienicius,* in his *Theatrum Cometicum*; but more ſatisfactorily by *Hevelius,* in his *Prodromus Cometicus,* and *Cometographia.* For the Theory of the *Comets,* ſee Sir *Iſaac Newton's Principia*; Dr. *Gregory's* Aſtronomy; and Dr. *Halley's* Paper upon the *Aſtronomy of Comets,* in the Philoſophical Tranſactions, N° 297.

[d] See Dr. *Halley,* Mr. *Whiſton,* and ſeveral Papers in the *Philoſophical Tranſactions,* upon the *Aurora Borealis.* See alſo *Morhof's Polyhiſtor,* Tom. II. Cap. 24. *de Meteoris Igneis.*

[e] There are ſome Papers upon this Subject in the *Philoſophical Tranſactions.*

[f] See the Author's Hiſtory of Winds, and Mr. *Bohun's* Diſcourſe concerning the Origin and Progreſs of Wind; printed at *Oxford,* 1671. See alſo the *Philoſophical Tranſactions*; and *Morhof, de Meteoris Aereis.*

[g] The Foundation of this Hiſtory ſeems laid by *des Cartes,* the *Archbiſhop of* Spalato, Sir *Iſaac Newton,* and M. *Huygens, de Coronis & Parheliis.* See alſo *Marcus Marci de Arcu cæleſti*; printed at *Prague* in 1648. and *Grimaldi's Phyſico-Matheſis, de Lumine, Coloribus, & Iride.* Ed. *Bononiæ* 1665. M. *Mariotte, des Couleurs,* &c.

[h] For the later Writers upon this Subject, See *Morhof's Polyhiſtor,* Tom. II. Cap. 27. *de Meteoris Aqueis.*

[i] The Foundations of this *Hiſtory* are laid in Sir *Iſaac Newton's* Treatiſe of *Opticks.* And for other Writers upon it, See *Morhof, de Iride, ac reliquis Meteoris emphaticis*; and the *Philoſophical Tranſactions.*

10. *The* History of common Rain, ſtormy Rain, prodigious Rains, Cataracts, Spouts [k], *&c.*

11. *The* History of Hail, Snow, Froſt, Hoar-froſts, Miſts, Dews [l], *&c.*

12. *The* History of all other Bodies, deſcending from, or generated above [m].

13. *The* History of Sounds *in the upper Regions; if there be any be-beſides Thunder* [n].

14. *The* History of the Air, *conſidered as a whole; or with regard to the Configuration of the World* [o].

15. *The Hiſtory of Seaſons, or Temperatures of the Air; both with regard to the difference of Countries, the accidents of Times, and the periods of Years; as alſo of Inundations, Heats, Droughts, and the like* [p].

16. *The Hiſtory of the Earth and Sea; their Figure, Circumference, and Conformation to each other; with their Order of Extenſion, as to breadth or narrowneſs; of the Iſlands, and Bays of the Sea; Salt Lakes in the Earth; Iſtmus's, Promontories* [q], &c.

17. *The Hiſtory of the Motions of the terraqueous Globe, and of the Experiments to be made for determining the ſame* [r].

18. *The Hiſtory of the greater Motions and Perturbations in the Earth and Sea; Earthquakes, Tremblings, Chaſms, New-Iſlands, Floating-Iſlands, Breaches by the Entrance of the Sea, drowning of Lands, Waſtes deſerted by the Sea, fiery Irruptions from the Earth, ſudden Irruptions of Water from the Earth* [s], &c.

19. *The* Natural Geographical History *of Mountains, Valleys, Woods, Plains, Deſerts, Meers, Lakes, Rivers, Torrents, Springs; with all the diverſities of their Origin, and the like; excluſive of Nations, Provinces, Cities, and other civil Conſiderations* [t].

20. *The Hiſtory of the* Flux *and* Reflux *of the Sea, its Alternations, Undulations, and other Motions* [u].

21. *The*

[k] The Royal Society of *London*, and the Royal Academy of *Paris*, appear to be collecting together numerous Obſervations, made in different Parts of the World, with relation to this Subject. See the *Philoſophical Tranſactions*, and *French Memoirs*. See alſo *Bohun* of *Wind*, and *Morhof, de Meteoris Aqueis*.

[l] Mr. *Boyle's* Philoſophical Works, the *Philoſophical Tranſactions*, and the *French Memoirs*, contain many Particulars relating to this Hiſtory. See likewiſe *Morhof, de Meteoris Aqueis*.

[m n o p] See Mr. *Boyle's Memoirs for a general Hiſtory of the Air*; *Morhof's Polyhiſtor, de Aere*, and *Boerhaave's* Chemiſtry, in the *Chapter* of Air.

[q r] Theſe ſeveral Hiſtories are proſecuted by *Varenius*, in his *Geographia Generalis*. See Dr. *Jurin's* Edition of that Work; printed at *Cambridge*, 1712.

[s] See the *Philoſophical Tranſactions*; and ſeveral of Mr. *Boyle's Philoſophical Pieces*.

[t] See *Voſſius de Motu Marium*; Dr. *Wallis's* Hypotheſis about the *Flux and Reflux of the Sea*, in the *Philoſophical Tranſactions*; Sir *Iſaac Newton's Principia Philoſophia Naturalis Mathematica*; and *Morhof's Polyhiſtor*, Tom. II. Cap. 20. *de Mare*, &c.

21. *The History of other accidents of the Sea; its Saltness, diversity of Colour, Depth; and of the submarine Regions, Rocks, Mountains, Valleys* [v], &c.

II.
THE HISTORIES OF THE ELEMENTS, OR GREATER ASSEMBLAGES OF MATTER.

22. *The* History of Flame, *and Bodies ignited* [w].
23. *The* History of Air, *in Substance, not Configuration* [x].
24. *The* History of Water, *in Substance, not Configuration* [y].
25. *The* History of Earth, *and its diversity, in Substance, not Configuration* [z].

III.
THE HISTORIES OF PARTICULAR SPECIES.

26. *The History of the perfect Metals, Gold and Silver; with their Ores, Veins, Marcasites; and the ways of working them from the Mine* [a].
27. *The* History *of* Quicksilver. [b]
28. *The* History of Fossils; *as Vitriol, Sulphur* [c], &c.
29. *The* History of Gems; *as the Diamond, the Ruby* [d], &c.
30. *The* History of Stones; *as Marble, Flint* [e], &c.
31. *The* History of the Loadstone [f].

32. *The*

[v] See Mr. *Boyle* of *the Submarine Regions*; and the *Saltness of the Sea*: and Count *Marsigli's* Natural *History* of the *Danube, and of the Sea.*

[w] Mr. *Boyle* has touched upon this Subject, in his Treatises of *Phosphori*, and the *Ponderability* of *Fire* and *Flame.*

[x] See Mr. *Boyle's Memoirs for a Natural History of the Air.*

[y] See Mr. *Boyle's Philosophical Works*, passim; *Boerhaave's* Chapter of *Water*, in his *New Method of Chemistry*; and *Morhof's* Chapter *de Aqua*, in his *Polyhistor*, Tom. II. Cap. 19.

[z] Mr. *Evelyn* has treated this Subject, in his *Terra.* For other Writers upon it, consult *Morhof's Polyhistor*, Tom. II. Cap. 21. *de Terra.*

[a] For the Writers in this way consult *Webster's Metallographia*; but some of the principal are *Alonso Barba, Lazarus Ercker, Glauber, Kunckel, Becher*, and *Stahl.*

[b] *Georg. Agricola* began this History, in his Work *de re Metallica*; and the *Authors* last mentioned have continued it. There are also some Papers upon this Head in the *Philosophical Transactions.*

[c] See *Boerhaave's* Chemistry; *Stahl's* several Chemical *Pieces*; Dr. *Woodward* on *Fossils*; and the *Philosophical Transactions*: but a capital Work in this way, is *Michael. Mercati Metallotheca*, published at *Rome*, with *Notes*, by *Johan. Mar. Lancisi*, Anno 1717. See also *Morhof's Polyhistor.* Tom. II. Cap. 29. *de Mineralibus in genere.*

[d] Mr. *Boyle* has an express Treatise upon this Subject; and for other Writers upon it, see *Morhof's Polyhistor, de Lapidibus, eorumque Generatione*, &c. Tom. II. Cap. 30.

[e] Mr. *Boyle* has some curious Observations, up and down his *Philosophical Works*, relating to this Subject. See also Dr. *Lister*, Dr. *Woodward*, and the other Writers of *Natural History.*

[f] The Subject of the Loadstone is treated by *Kircher*, Mr. *Boyle*, the *Philosophical Transactions*, Mr. *Whiston*, and many more.

32. *The* History of miscellaneous Bodies, *neither perfectly Mineral, nor perfectly Vegetable; as Salt, Amber, Ambergrease* [g], &c.
33. *The* Chemical History of Metals *and* Minerals [h].
34. *The* History of Vegetables, *Trees, Shrubs, Plants, and their Parts; as Roots, Trunks, Woods, Leaves, Flowers, Fruits, Seeds, Droppings, Tears, Weepings* [i], &c.
35. *The* Chemical History of Vegetables [k].
36. *The* History of Fish, *their Parts, and manner of Generation* [l].
37. *The* History of Birds, *their Parts, and manner of Generation* [m].
38. *The* History of Beasts, *their Parts, and manner of Generation* [n].
39. *The* History of Serpents, *Worms, Flies, and other Insects; their Parts, and manner of Generation* [o].
40. *The Chemical History of animal Matters* [p].

IV.

THE HISTORIES RELATING MORE IMMEDIATELY TO MAN.

41. *The* History of the Figure, and external Parts of Man; *his Stature, Conformation, Countenance and Lineaments; with the Varieties thereof, according to Nation, Climate, or other smaller Differences* [q].
42. *The* History of human Physiognomy, *to be drawn from the foregoing* [r].
43. *The*

[g] The later Writers of *Natural History* treat also of these. See *Morhof's Polyhistor.* Tom. II. Cap. 37. *de Mediis Mineralibus.*

[h] See *Becher, Kunckel, Stahl,* and *Boerhaave,* in their Chemical Pieces.

[i] Mr. *Ray's Historia Plantarum,* Dr. *Grew's Anatomia Plantarum, Malpighi's Anatomia Plantarum,* and several Papers in the *German Ephemerides,* nobly prosecute this Subject, in particulars.

[k] A Method is chalk'd out, and a Foundation laid, for this *History,* in *Boerhaave's* Chemistry, and some of Mr. *Boyle's* Pieces; as particularly his *History of human Blood.*

[l] *Hermanus Conringius* has collected all the Authors, both ancient and modern, that treat of this Subject. See also *Willoughby's Ichthyologia.*

[m] See *Willoughby's Ornithologia,* the *Philosophical Transactions,* and *Morhof's Polyhist.* Tom. II. Cap. 46. *Miscella quædam de Animalibus.*

[n] See Dr. *Harvey, de Generatione Animalium, Kerkringius's Anthropogenia Icnographia;* the *French Memoirs;* and particularly the *Memoires de l'Academie Royale, pour servir à l'Histoire des Animaux.* See also *Morhof, Polyhist.* Tom. II. Cap. 45.

[o] See *Aldrovandus, Sam. Bochart, Hook, Swammerdam, Rhedi, Andry, Malpighi,* &c.

[p] *Boerhaave* has reduced this Subject to a just Method; and put it in the way of a proper Treatment. See the Processes upon Animals, in his *Chemistry.*

[q] The *Chinese* appear to have cultivated this Subject more than the *Europeans,* even so far as from thence to form a Judgment of Men's Morals; their Guilt or Innocence, in Criminal Cases, &c. See *Wolfius upon the Chinese Philosophy,* and the *Missionaries Letters.* Consult also *Camillus Baldus* upon *Aristotle's Physiognomica;* as likewise his Pieces *de humanarum Propensionum ex temperamento Pravitatibus,* &c. *Ed. Bononiæ,* 1664. *& Scip. Clermont, de Conjectandis latentibus animi affectibus.*

[r] See the *Characters of Theophrastus,* with *Casaubon's Notes; Morhof de Artibus divinatoriis & Magia, in Polyhist.* Tom. II. Lib. III. and Mr. *Evelyn's Appendix* to his *Discourse upon Medals.*

43. *The* History of human Anatomy; *or, of the internal Parts of Man; with their Variety found in the natural Structure and Conformation; and not only as preternaturally altered by Accident or Diseases* [s].

44. *The* History of the similar Parts of Man; *as the Flesh, Bones, Membranes* [t], &c.

45. *The History of the Humors in Man; the Blood, the Bile, the Seed* [u], &c.

46. *The* History of the human Excrements; *the Saliva, the Urine, the Sweat, the Fæces, the Hair of the Head, the Hair of the Body, the Nails, the Skin of the Nails* [v], &c.

47. *The History of the* Faculties of the Body; *Attraction, Digestion, Retention, Expulsion, Sanguification, Assimilation of the Aliment into the Parts of the Body, and the Conversion of Blood, and the fine part thereof, into Spirit* [w], &c.

48. *The* History of natural and involuntary Motions; *as those of the Heart, the Pulse, the Lungs, Sneezing, Yawning, Erection of the Penis* [x], &c.

49. *The History of the mixed Motions, compounded of natural and voluntary; as Respiration, Coughing, the making of Urine, going to Stool* [y], &c.

50. *The History of voluntary Motions; as, of the Organs of Speech, the Motions of the Eyes, the Tongue, Jaws, Hands, Fingers, Throat in swallowing* [z], &c.

51. *The History of Sleep and Dreams* [a].

52. *The* History of the various Habits of the Body; *as to Fat, Lean, Complexion, Constitution* [b], &c.

53. *The*

[s t] These Subjects have been diligently prosecuted by the *Modern Anatomists*, in all the solid Parts of the Body; thus Dr. *Willis* and *Malpighi* have carefully traced and anatomized the *Brain*, and *Nerves*; *Steno* the Muscles; *Bellini* and *Malpighi* the Tongue; *Cæcilius Folius* and *du Verney* the Ear; *Bartholin* the Lungs; *de Graaff* the Parts of Generation; *Havers* the Bones, &c. A summary History of all which is given us by *Boerhaave*, in his *Institutiones Medicæ*. 'Tis pity but the *History of the Animal Fluids* were extant with equal exactness.

[u] This *History* is almost deficient, and requires a particular Chemical and Philosophical Treatment. Mr. *Boyle's* History of human Blood; and *Boerhaave's* Processes upon Animals, may pave the way for it.

[v] This *History* also seems, in a manner, untouched: *Boerhaave*, in his *Institutiones Medicæ*, has collected the sum of what has been done upon it. See also *Morhof's Polyhist.* Tom. II. Lib. II. Cap. 47. *de Homine.*

[w] Neither has this Subject been prosecuted as it deserves; but *Boerhaave* has made great use of the present Discoveries, to shew it to Advantage, in his *Institutiones Medicæ.*

[x y z] See the whole of these Doctrines, so far as they are known at present, aphoristically deduced in *Boerhaave's Institutiones Medicæ.*

[a] The *History of Dreams* seems still deficient; tho an Enquiry worthy the Prosecution. But the Foundations for the History of Sleep are laid by *Boerhaave*, in the Treatise abovementioned.

[b] Nothing very considerable seems hitherto done, towards furnishing out this *History.*

53. *The* History of human Generation [c].

54. *The History of human* Conception, Quickening, Geſtation, Birth [d], *&c.*

55. *The History of* human Alimentation, *all kinds of Eatables, Drinkables and Diet; with their Variety, according to the difference of Nation, or leſſer Matters* [e].

56. *The* History of the Growth and Increaſe of the human Body, *both in the Whole, and its Parts* [f].

57. *The* History of human Age, *Infancy, Childhood, Youth, old Age, long Life, ſhort Life,* &c. *according to different Nations, and leſſer Differences* [g].

58. *The* History of Life and Death [h].

59. *The* medicinal Hiſtory of Diſeaſes, *with their Signs and Symptoms* [i].

60. *The* medicinal Hiſtory of Curation, *Remedies, and Relief from Diſtempers* [k].

61. *The medicinal Hiſtory of ſuch things as preſerve the Body in a healthy State* [l].

62. *The medicinal Hiſtory of ſuch things as regard the gracefulneſs and comelineſs of the Body* [m], &c.

63. *The medicinal Hiſtory of ſuch things as change the Body, and belong to an alterative Regimen* [n].

64. *The Hiſtory of Pharmacy* [o].

65. *The*

[c] This has been proſecuted, tho not advanced to perfection; for it ſtill remains undetermined, whether Generation is performed by means of the *Animalcula in ſemine Maſculino*, or not: tho the general Opinion ſeems to favour the affirmative.

[d] The Buſineſs of Conception and *Quickening* remains to be farther enquired into; nor, perhaps, are the beſt Methods of delivering Women in *difficult Births* hitherto diſcovered.

[e] This Subject has not been ſatisfactorily proſecuted; but Dr. *Arbuthnot* very lately ſhew'd how the *Enquiry* might be conducted to Advantage, in his *Diſcourſe of Aliments*.

[f] Some Mechanical Attempts have of late been made to deduce this Hiſtory; but not, perhaps, with that Care and Exactneſs the Subject requires.

[g] There ſeems to be little ſatisfactory, or uſeful, extant upon this Subject.

[h] The Foundations for this Hiſtory are firmly laid by the Author, in his particular *Enquiry into Life and Death*: but certainly the Subject has not been duly proſecuted ſince, as its importance requires. See *Morhof, Polyhiſt.* Tom. I. Lib. II. Cap. 5. *de Tempore*.

[i k] How little that is ſolid and uſeful, has been done towards theſe two *Hiſtories*, may appear from the *Aphoriſms* of *Boerhaave, de Cognoſcendis & Curandis Morbis*; which are a Summary of the ancient and modern Doctrine upon the Subject. See alſo *le Clerc's Hiſtoire de la Medicine*.

[l] Nothing in *Medicine* is, perhaps, more wanted than this *Hiſtory*; eſpecially with regard to *Heat* and *Cold*, and other external and internal Cauſes of Diſtempers. See *Quincy's* Edition of *Sanctorius's* Aphoriſms; *Keil's Tentamina Medica*; and *Wainwright* on the *Non-Naturals*.

[m] This *Hiſtory* alſo is, in great meaſure, deficient.

[n] The Author affords ſome Notices for this Hiſtory, in his Enquiry into *Life and Death*: but they appear to have been little regarded.

[o] The *Hiſtory of Pharmacy* is by no means extant, in the manner required by the Author; that is in the aphoriſtical manner: with a due rejection of uncertainties, ſuperfluities, phantaſtical Traditions, ill-grounded Opinions, *&c.* But for bulkineſs and number of Writers, it may rival moſt other Hiſtories.

65. *The Hiſtory of Chirurgery* [n].
66. *The chemical Hiſtory of Medicines* [o].
67. *The Hiſtory of Sight, and viſible Objects* [p].
68. *The Hiſtory of Painting, Sculpture, Statuary* [q], &c.
69. *The Hiſtory of* Sounds, *and* Hearing [r].
70. *The Hiſtory of Muſick* [s].
71. *The Hiſtory of Odours, and the Smelling* [t].
72. *The Hiſtory of Taſtes, and Taſting* [u].
73. *The Hiſtory of the Touch, and its Objects* [v].
74. *The* Hiſtory of the Act of Venery, *as a Species of Touch* [w].
75. *The Hiſtory of bodily Pains, as a kind of Touch* [x].
76. *The* Hiſtory of Pleaſure and Pain *in general* [y].
77. *The* Hiſtory of the Paſſions; *as, Anger, Love, Baſhfulneſs* [z], &c.
78. *The* Hiſtory of the intellectual Faculties; *as Thought, Imagination, Reaſoning, Memory* [a], &c.
79. *The* Hiſtory of natural Divinations [b].
80. *The* Hiſtory of Diſcernments, *or occult natural Judgments* [c].

[n] The *Hiſtory of Chirurgery* ſeems proſecuted more carefully than Pharmacy, and reduced to a tolerable Simplicity; tho capable, perhaps, of much greater Certainty, and farther Improvement. See the preſent Summary of its Doctrine, in *Boerhaave*'s Aphoriſms *de Cognoſcendis & Curandis Morbis.*

[o] Materials for this *Hiſtory* are extant in great Variety; but they require Verifying and Rejection. See a Summary of it, as it ſtands at preſent, in *Boerhaave*'s *Chemiſtry.*

[p] The Foundation for this Hiſtory is laid by Dr. *Hook*, in his *Micographia*; *Leeuwenhoek*, in the *Philoſophical Tranſactions*; Mr. *Molyneux*, in his *Dioptricks*; Sir *Iſaac Newton*, in his Treatiſe of Light and Colours; *Barrow*'s *Lectiones Optica*; and *Gregory*'s *Elementa Dioptrica & Catoptrica.*

[q] For this *Hiſtory* conſult, among others, *Gerard de Laireſſe*, in his *Principes du Deſſein, Aſtelodam.* 1718. *Felibien*'s *Entretiens ſur les Vies, & ſur les Ouvrages des plus excellens Peintres*; or his *Abregé de la Vie des Peintres*, printed at *Paris* in 1715.

[r] This Hiſtory is proſecuted by Mr. *Boyle*; the Philoſophical Tranſactions; *French* Memoirs, and many of the modern Writers.

[s] Mr. *Malcolm* ſeems to have begun the *Hiſtory of Muſick*, in the ſolid rational Way intended by the Author. See Mr. *Malcolm*'s *Treatiſe of Muſick, ſpeculative, practical, and hiſtorical*; printed at *Edinburgh*, 1721.

[t u v] Mr. *Boyle* has laid the Foundations for theſe *Hiſtories*, in his *Enquiry into the Origin of Forms and Qualities*; and the ſeveral ſubſequent *Pieces* to that leading Enquiry. See alſo *Morhof*'s *Diſſertatio de Paradoxis Senſuum.*

[w] The Author has ſomewhat upon this Head, in his following *Piece*, or, *Sylva Sylvarum.* And the learned *Jacob. Thomaſius* wrote a Diſſertation, *De Senſu Sexto, ſive Titillatione Venerea.*

[x] This uſeful Subject ſeems to remain uncultivated, except a little by Phyſicians.

[y] The phyſical Enquiry into Pleaſure and Pain ſeems to be much neglected, tho a Matter of great importance.

[z] See *Des Cartes*, *M. Senault*, and Mr. *Hutchinſon*, upon the Paſſions.

[a] Mr. *Locke*'s *Eſſay upon Human Underſtanding*, may ſeem to have begun this *Hiſtory*; to which add Father *Malbranche*'s *Reſerche de la Verité*, and the ſeveral Pieces of Mr. *Berkley.*

[b c] Conſult upon theſe Heads, *Morhof*'s *Polyhiſt. Tom.* II. *Lib.* III. *De Artibus Divinatoriis, & Magia.*

81. *The* Hiſtory of Cookery, *and the Arts ſubſervient to it; as that of the Graſier, the Butcher, the Poulterer* [d], &c.
82. *The* Hiſtory of Bread, *Paſtery, and Baking, with the Arts ſubſervient thereto; as the grinding of Flower* [e], &c.
83. *The* Hiſtory of Wines [f].
84. *The* Hiſtory of the Cellar, *and different kinds of Drinks* [g].
85. *The* Hiſtory of Confectionary Wares [h].
86. *The* Hiſtory of Honey [i].
87. *The* Hiſtory of Sugar [k].
88. *The* Hiſtory of *the* Dairy [l].
89. *The* Hiſtory of *the* Bagnio; *as ſweating, bathing, and anointing the Body* [m].
90. *A miſcellaneous Hiſtory with regard to neatneſs and elegance of the Body; as of Depilatories, Perfumes* [n], &c.
91. *The* Hiſtory of working in Gold; *with the Arts thereto ſubſervient* [o].
92. *The* Hiſtory of working in Wool; *with the Arts thereto belonging* [p].
93. *The* Hiſtory of working in Silk; *with the Arts thereto belonging* [q].

94.

[d] [e] There ſeems to be little extant upon theſe Subjects, in the true phyſical Way; or that of *natural Enquiry*.

[f] [g] Theſe Subjects have been proſecuted by ſeveral; but ſtill there remain ſuch conſiderable things to be done, by means of a few ſlight Improvements therein, as few would credit, except Eye-witneſſes. See *Baccius*'s *Hiſtoria Natalis Vinorum*; *Sachius*'s *Ampelographia*; *Hauptman de inſignibus Viticultura Erroribus*; Roſa's *Engliſh* Vineyard vindicated; the Myſtery of *Vintners*; the *Vinetum Britannicum*; *Willis de Fermentatione*; *Meibomius de Cereviſiis*; *Glauber*'s Works; *Boerhaave*'s Chemiſtry; and *Stahl*'s *Zymotechnia Fundamentalis*.

[h] This *Hiſtory* ſeems, in a manner, deficient; and muſt be derived from the Hiſtory of *Sugar*.

[i] This Hiſtory of *Honey*, ſhould include not only the ways of collecting the Honey; but alſo the Manufactures thereof, into *potable Liquors, Preſerves, Medicines, Sugars*, &c. which has ſcarce been touched upon; tho a Subject of great Utility. *Glauber* has given Intimations about it; but there are few who regard them.

[k] The phyſical *Hiſtory of Sugar* deſerves to be reckoned a capital Thing; as capable of affording great Advantages to Mankind in general, and more particularly to the Inhabitants of *England*. The Author ſeems apprized of it, and, in his *Sylva Sylvarum*, expreſly recommends an Experiment to be made upon this Subject; which, in skillful Hands might prove immenſely ſerviceable. See *Piſo*'s Hiſtory of the *Indies*; *Barlæi Deſcriptio Rerum ſub Mauritio in Braſilia geſtarum*; *Angel. Sala Saccharologia*; Mr. *Boyle* on the Uſefulneſs of Natural Philoſophy; Sir *Hans Sloan*'s Natural Hiſtory of *Jamaica*; Dr. *Slare* on *Sugar*; Dr. *Stahl*'s *Zymotechnia Fundamentalis*; and his Philoſophical Principles of Chemiſtry.

[l] This has been but little conſider'd, by the profeſſed Naturaliſts and Philoſophers, tho worthy of their Attention. Some chemical Operators have a way of diſtilling *Brandy* from *Whey* and *Buttermilk*.

[m] Some Attempts have been made, by the Moderns, to revive the ancient Practices in theſe Particulars; but the Subject has not been duly cultivated, and improved, as it deſerves.

[n] Tho it were eaſy to proſecute this Hiſtory, yet, perhaps, little conſiderable has been done in it by the Moderns.

[o] [p] [q] [r] [s] [t] [v] [u] [w] [x] [y] [z] [a] [b] [c] [d] Theſe ſeveral Hiſtories are but imperfectly extant; and ſome of them ſcarce touched upon. Memoirs for them may be found in the Philoſophical Tranſactions; the *French* Memoirs; the *German Ephemerides*; *Morhof*'s *Polyhiſtor*; the Writers of

94. *The Hiſtory of working in Flax, Hemp, Cotton, Hair, Briſtles, and other Subſtances affording a Thread; with the Arts thereto belonging* [r].
95. *The Hiſtory of working in Feathers* [s].
96. *The* Hiſtory of Weaving; *with the Arts belonging to it* [t].
97. *The Hiſtory of Dying* [u].
98. *The Hiſtory of working in* Hides, Skins, *and* Leather; *with the Arts thereto ſubſervient* [v].
99. *The Hiſtory of Beds, Ticks, Down, and Feathers* [w].
100. *The Hiſtory of working in Iron* [x].
101. *The Hiſtory of Stone-cutting* [y].
102. *The* Hiſtory of Bricks and Tiles [z].
103. *The* Hiſtory of Pottery [a].
104. *The Hiſtory of working in Plaiſter of* Paris, Terras, *and Cements* [b].
105. *The Hiſtory of working in Wood* [c].
106. *The Hiſtory of working in Lead* [d].
107. *The* Hiſtory of Glaſs, *Glaſing, and all vitrious Bodies* [e].
108. *The Hiſtory of Architecture in general* [f].
109. *The Hiſtory of Carriages, Coaches, Waggons, Litters* [g], &c.
110. *The* Hiſtory of Printing, Writing, Sealing, Book-making, Ink, Pens, Paper, Parchment [h], *&c.*
111. *The Hiſtory of* Wax, *natural and artificial* [i].
112. *The Hiſtory of Twig-works; or the making of Oſier Baſkets* [k], &c.
113. *The Hiſtory of Mat-work; or the pleating, weaving, and working of Straw, Ruſhes* [l], &c.
114. *The* Hiſtory of the Laundry; *all kinds of cleanſing, ſcouring* [m], &c.

of *Natural Hiſtory*; and the Writers upon new chemical Diſcoveries; as, particularly, *Glauber, Becher, Kunckel, Homberg*, and *Stahl*. But the due Execution we expect from the illuſtrious *Academy of Sciences* at *Paris*.

[c] The *Hiſtory of Glaſs* has been laudably proſecuted by *Neri, Merret*, and *Kunckel*, in a regular Series after one another; the two latter adding their *Notes* and *Improvements* upon the former: a Method deſerving of Imitation in other *Hiſtories of Arts*. See alſo *Blancour's Art of Glaſs*.

[f] *Architecture* has of late been conſiderably cultivated: the Foundations of it are laid by Sir *Henry Wotton*, in his Elements of Architecture; *M. Perrault's Architecture generale de Vitruve, reduite en Abregé*; *Leo Baptiſta de Albertis, de Re Ædificatoria*; and *Felibien's Entretiens Hiſtoriques de la Vie & des Ouvrages des plus celebres Architectes*.

[g] The modern Writers in Mechanicks have proſecuted this Subject; particularly certain Members of the *Royal Academy of Sciences* at *Paris*. See alſo Biſhop *Wilkins's Dadalus*; Dr. *Hook's* mechanical Pieces; *Wolfii Elementa Matheſeos*; and the Writers of Courſes of Experimental *Philoſophy*.

[h] See the firſt Rudiments of this Hiſtory in *Morhof, Struvius*, and *Stollius*.

[i] See the Hiſtory of *Wax*, in the Writers on *Drugs*; as *Pomet, Lemery*, and *Savary's French* Dictionary of Commerce: but for the Hiſtory of *Wax-chandlery*, I have not met with it; tho there are ſome Materials to be collected for it from *Salmon's Polygraphice*, and the other Writers of artificial Curioſities.

[k l m] I do not find theſe *Hiſtories* extant, in any tolerable Perfection.

115. *The Hiſtory of* Agriculture, Paſturage, Wood-lands [n], *&c.*
116. *The* Hiſtory of the Garden, *or Horticulture* [o].
117. *The* Hiſtory of Fiſh-ponds, *and the breeding of* Fiſh [p].
118. *The* Hiſtory of Hunting and Fowling [q].
119. *The* Hiſtory of War, *and the Arts ſubſervient to it; as Armory, Bow-making, Arrow-ſmithery, Gun-ſmithery, Gun-foundery, Fortification* [r], &c.
120. *The* Hiſtory of Navigation, *with all the practical parts thereof, and the Arts thereto belonging* [s].
121. *The* Hiſtory of Fencing, Wreſtling, *and all kinds of manly Exerciſes* [t].
122. *The* Hiſtory of Horſemanſhip [u].
123. *The Hiſtory of* Sports, *of all kinds* [v].
124. *The Hiſtory of Jugling, ſlight of Hand, and feats of Activity* [w].
125. *A miſcellaneous Hiſtory of various artificial Matters; as Enamels, Paſtes, Cements* [x], &c.
126. *The Hiſtory of* Salts [y].

127.

[n] Many Materials for this Hiſtory are collected in the *Philoſophical Tranſactions*, and the *French Memoirs*. For particular Writers upon the Subject, See *Morhof's Polyhiſt. Tom.* II. *Part.* II. *Cap.* 40. *de Plantis & Vegetatione. Cap.* 41. *de Propagatione & Melioratione Plantarum*, &c. See alſo Mr. *Evelyn* and Dr. *Bradley*, upon the Subject.

[o] This Subject has been conſiderably cultivated of late. See the Author's laſt mentioned; *Sharrock's* Hiſtory of the Propagation and Improvement of Vegetables; Sir *Kenelm Digby* of Vegetation; Dr. *Laurence* on Gardening; Mr. *Hales's* Vegetable Staticks; and Mr. *Miller's* Gardener's Dictionary.

[p] This Subject has rather fallen under the Treatment of Sportſmen, than Philoſophers. See, however, *Rondeletius*, and *Salvianus*, *de Aquatilium Animalium Hiſtoria*; and *Conringius's* Collection of the Writers on this Head. The Philoſophical Tranſactions; the *French* Memoirs; Mr. *Boyle's*, and Mr. *Ray's* philoſophical Pieces; and *Willoughby's Ichthyologia*, likewiſe afford many Particulars to this Purpoſe.

[q] See the *Scriptores Rei accipitrariæ*, publiſhed at *Paris* in 1612; and *Paulus Merula's Dutch* Treatiſe of all kinds of Hunting; alſo the *French Venerie Royale*; and *Johan. Caii Liber de Canibus Britannicis.*

[r] The Writers upon this Subject are numerous; but a capital one is, *Grabriel Naudé de Studio Militari, Ed. Romæ*, 1637. See alſo *Schelius ad Caſtra Polybiana*; and *Wolfii Brevis Commentatio de Scriptis Mathematicis*, at the End of his *Elementa Matheſeos Univerſæ.* See alſo Father *Aquino's Lexicon Militare*, printed at *Rome* 1724.

[s] This Subject is proſecuted, in a large Volume, by Mynheer *Witſen*, in *Low Dutch*; and might well deſerve to be made *Engliſh.*

[t] See Sir *William Hope's* New Method of Fencing; *M. Thibaut's Academie de l'Epée*; *Morhof Polyhiſt. Tom.* II. *Lib.* IV. Sir *Thomas Parkyns's* Inn-Play; or, *Corniſh-Hug Wreſtler*; *Petter*, the Vintner of *Amſterdam*, in his *Dutch* Book printed at *Amſterdam*, 1674. But theſe Subjects require to be more phyſically conſidered.

[u] See *M. Sorel*; the Farrier's Guide; *Gibſon's* Method of dieting Horſes, *&c.*

[v] The Writers in this Way are numerous, and within every one's Obſervation; but the phyſical Hiſtory of *Sports* ſeems to be ſtill wanting.

[w] The common Books upon theſe Subjects are not the things here intended: as being deficient in deſcribing the particular Methods of training up, and habituating the Body, by proper Exerciſes, for Tumbling, Rope-dancing, *&c.*

[x] See *Neri*, *Merret*, *Kunckel*, and *Blancour*, upon the Art of Glaſs.

[y] Mr. *Boyle*, Sign. *Guglielmini*, *M. Homberg*, and Dr. *Stahl*, may ſeem to have laid the Foundations of this *Hiſtory.*

127. *A miſcellaneous Hiſtory of various Machines and Motions* [z].
128. *A miſcellaneous Hiſtory of common Experiments, not yet formed into Arts* [a].

The *Hiſtories* of pure Mathematicks ſhould alſo be written; tho theſe require Obſervation rather than Experiment. We therefore ſet down
129. *A Hiſtory of the Natures and Powers of* Numbers [b].
130. *A Hiſtory of the Natures and Powers of* Figures [c].

A CATALOGUE *of Capital* ENQUIRIES *regarding the more immediate* SERVICE OF MANKIND.

1. AN *Enquiry into the Ways of prolonging Life* [a].
2. *An Enquiry into the Means of reſtoring Youth in ſome degree* [b].
3. *An Enquiry into the Methods of retarding old Age* [c].
4. *An Enquiry into the ways of curing Diſeaſes accounted incurable* [d].
5. *An Enquiry after more eaſy and leſs loathſome ways of Purging* [e].
6. *An Enquiry into the Ways of increaſing the ſtrength and activity of the Body* [f].
7. *An Enquiry into the Ways of mitigating Pain, and increaſing the human Ability for enduring Torture* [g].
8. *An Enquiry into the Ways of altering the Conſtitution, or Habit of the Body; as to Corpulency, Leanneſs* [h], &c.
9. *An Enquiry into the Ways of altering the Statures of Men* [i].
10. *An Enquiry into the Ways of altering the human Features* [k].
11. *An*

[z] See the ſeveral Writers upon *Mechanicks*; as, particularly, *M. Varignon*, and *Wolfii Elementa Matheſeos Univerſæ*.

[a] Numerous Experiments of this kind occur among the *chemical Writers*; more eſpecially in the philoſophical and chemical Pieces of Mr. *Boyle*, *Becher*, *Kunckel*, *Glauber*, *Homberg*, *Stahl*, *Hoffman*, and *Boerhaave*.

[b] See the *French* Memoirs; the Mathematical Pieces in the *Philoſophical Tranſactions*; and the numerous modern Writers in *Mathematicks*; particularly Mr. *Malcolm*'s late Work, entitled, *A new Syſtem of Arithmetick, theorical and practical*.

[c] See the later *Mathematicians*; and, particularly, *Wolfius*'s *Elementa Matheſeos Univerſæ*.

[a b c] Theſe Enquiries the Author himſelf has begun, after his own Method of Induction, in the *Hiſtory of Life and Death*: but who has followed him, in the ſame Method, upon theſe important Articles?

[d] The Attempts hitherto made to this purpoſe have been but feeble, and no way anſwerable to the importance of the Subject; which is attended with more Difficulties than properly belong to it.

[e] This Enquiry might now be cut ſhort; by a prudent Uſe and Treatment of ſome *Mineral Purging Waters*, and a more judicious Management of the purging Simples. But here, again, more Difficulties are to be encountered, than naturally grow out of the Subject.

[f g] Theſe noble Enquiries ſeem to lie neglected; perhaps thro' an untimely Deſpondency, that little can be effected in them: yet the ancient *Athleticks*, and the *Spartan Diſcipline*, might teach us better.

[h i k] By a ſtrange Fatality, Phyſicians proceed as if theſe kind of Enquiries did not belong to their Art; which can never receive any great Improvement, whilſt it moves in ſo narrow a Sphere.

11. *An Enquiry into the Ways of improving and exalting the intellectual Powers, or faculties of the Mind* [l].
12. *An Enquiry into the Ways of converting Bodies into one another* [m].
13. *An Enquiry into the Ways of producing new Species of Bodies* [n].
14. *An Enquiry into the Methods of tranſplanting one Species of Bodies into another* [o].
15. *An Enquiry after new Inſtruments of Deſtruction, in the way of War, Poiſon* [p], &c.
16. *An Enquiry into the ways of exhilirating the Spirits, and bringing them to good Temper* [q].
17. *An Enquiry into the Ways of working by the force of Imagination* [r].
18. *An Enquiry into the Ways of accelerating the time in Maturation, Clarification, Putrefaction, Vegetation, and Aſſimilation* [s].
19. *An Enquiry into the beſt, and cheapeſt, Methods of making rich Compoſts for Land* [t].
20. *An Enquiry into the Ways of operating upon the Air, as to the raiſing of Winds, Tempeſts, and governing the Weather* [u].
21. *An Enquiry into the Ways of procuring great Alterations in Bodies, with regard to Hardneſs, Softneſs, Fluidity, Firmneſs* [v], &c.
22. *An Enquiry after the Methods of turning crude and watery Subſtances, into oily and unctuous ones* [w].

23.

[l] See Sir *Henry Wotton's Survey of Education*; Mr. *Locke* on *Education*; and *Morhof's Polyhiſt. Tom.* I. *Lib.* I. *Cap.* XV. *de Converſatione Erudita*; *& Lib.* II. *Cap.* I. *de Delectu Ingeniorum*, *& Cap.* II. *de Officinis bonarum mentium*; *& Cap.* III. *de Facultatum animi Subſidiis*; *& Cap.* IV. *de Subſidiis dirigendi Judicii.*

[m n o] The generality of Philoſophers ſeem to lie under a kind of Incantation, with regard to theſe Subjects; and inſtead of enquiring diligently into them, make almoſt the bare mention of Tranſmutations, and new Productions, criminal: tho at the ſame time ſuch things are effected, by ordinary Operators, every Day.

[p] Some may imagine, that this Enquiry lies too open: it is certain that many extraordinary things might be effected in this Way; and natural Enquiries muſt not ſtop, becauſe they are capable of being converted to bad Purpoſes. See *Boerhaave's Chemiſtry*; of the *Ends and Uſes of the Art.*

[q] This capital Enquiry alſo lies uncultivated.

[r] That ſome extraordinary Effects are producible in this Way, muſt have come within every one's Obſervation; and yet, who has duly proſecuted the Enquiry, after the manner it is begun by the Author in his *Sylva Sylvarum*?

[s] The Author has ſome uſeful Obſervations upon theſe Heads in the following Piece; but the Subject is by no means duly proſecuted.

[t] See the Philoſophical Tranſactions, Sir *Kenelm Digby*, *Glauber*, Mr. *Boyle*, Mr. *Evelyn*, and the later Writers upon *Husbandry* and *Agriculture.*

[u] This muſt appear a ſtrange Enquiry to the unphiloſophical; and yet, whoever underſtands the Scope, Deſign, and Tendency, of the Author's Hiſtory of Winds, will not judge it a Subject above the reach of the human Capacity.

[v] That ſomewhat conſiderable may be done in this Way, appears from Mr. *Boyle's* Philoſophical Enquiries; the Uſe of the Digeſtor; and many Pieces in the Philoſophical Tranſactions, *French* Memoirs, *&c.*

[w] As Nature does every Day in Vegetation, and Animalization. See Mr. *Boyle's* Philoſophical Works.

23. *An Enquiry into the Methods of extracting new Foods, from Subſtances not now uſed for that purpoſe* [x].

24. *An Enquiry into the Ways of making new kinds of Threads, Cloths, Stuffs, and Paper; for Apparel, Furniture, Hangings* [y], &c.

25. *An Enquiry into the Methods of improving the buſineſs of* Natural Divination [z].

26. *An Enquiry after the Methods of deceiving, and impoſing upon the Senſes* [a].

27. *An Enquiry into the beſt Ways of heightening the Pleaſures of all the Senſes* [b].

28. *An Enquiry into the Ways of producing artificial Metals, Minerals, new kinds of Glaſs, Paſtes, and Cements* [c]. [d].

[x] This is an eaſy Enquiry, and open to every one's Diligence; yet who has treated it ſuitably to its Merit?

[y] Some Attempts have occaſionally been made in this Way; as by the hatchelling of Nettle-ſtalks, the weaving of Spiders Webs into a kind of Silk, the making of incombuſtible Paper from the Asbeſtus, *&c.* but the *Enquiry* is not, that I have met with, duly proſecuted.

[z] So as, for example, to diſcover the Tempers and Thoughts of Men, from their external Appearances. This Enquiry alſo is not proſecuted and brought to certain Rules for Practice; at leaſt, not in *Europe*.

[a] See *Morhof*'s Piece, *De Paradoxis Senſuum*; the *Reſerche de la Verité*; and Mr. *Berkley*'s Dialogues, *&c.*

[b] The Author has hereafter many Obſervations to this purpoſe. The Enquiry ſeems not difficult; but Men are, generally, too much taken up with enjoying the common Pleaſures of the Senſes, to beſtow time in conſidering how to heighten them, or diſcover new ones.

[c] The Proſecution of this Subject has been generally left to mechanical Operators, and accidental Trial: but if Philoſophers were to take it in hand, it ſeems capable of great Improvements. See Mr. *Boyle, Becher, Kunckel, Homberg, Stahl,* &c.

[d] The Procedure of Dr. *Childrey* upon theſe *Heads of Hiſtories*, is worthy of Imitation. In a Letter to Mr. *Oldenburg*, Secretary of the *Royal Society*, dated *July* 12, 1669. he writes thus: "I bought me as many Paper-Books, as my Lord *Verulam* has *Hiſtories* at the end of his "*Novum Organum*; in which I entered all the *philoſophical Matters*, I met with, obſervable "in my Reading; and intend to continue it." The ſame *Gentleman*, in the Year 1661. publiſhed a Book entitled *Britannia Baconica*; or, *the Natural Rarities of* England, Scotland, *and* Wales; *hiſtorically related, according to the Precepts of the Lord* Bacon. And this was followed by Dr. *Plot*'s *Natural Hiſtories of* Oxfordſhire *and* Staffordſhire. See *Wood*'s *Athenæ Oxonienſes*, *Vol.* II. *Pag.* 468. under the Article *Joſhua Childrey*.

SYLVA

SYLVA SYLVARUM:

OR,

MEMOIRS for a GENERAL HISTORY

OF

NATURE and ART.

ACCELERATION.

Acceleration a capital Enquiry.

ACCELERATION, is a capital Thing in the Works of Nature; and even, in divine Miracles, next to the creating of the Matter: whence all *Accelerations*, ſhould be diligently enquired into [a]. See the Articles BIRTH, GROWTH, CLARIFACTION, MATURATION, METALS, PUTREFACTION, and VEGETATION.

AFFECTIONS.

That the Spirits retire in Affections of the Body, illuſtrated in all the Senſes.

All very offenſive Objects of the Senſes, cauſe the *Spirits* to retire; and upon this Flight, the Parts are, in ſome degree, deſerted; whence they fall into a Trepidation and Horror. In *Sounds*; the grating of a Saw, or any very harſh Noiſe, ſets the Teeth on edge, and makes all the Body ſhiver. In

[a] In all the Works of Nature and Art, nothing is more deſirable and advantageous than Expedition, joined with Perfection. Hence, to produce Vegetables, to erect Buildings, cure Diſeaſes, and execute, in every kind, quick and thoroughly, is the Perfection of Art. There are many Methods of Acceleration, which ſhould ſeverally be ſought and deſcribed. Thus, for inſtance, one is by *dropping intermediate Operations*; as in the making of Vinegar, without *vinous Fermentation*, or the Delay of converting the Liquor firſt into Wine. This we find often done by accident, in *Brewing*; and might therefore be applied to ſhorten the common tedious Proceſs of *Vinegar-making*. So likewiſe a Species of Wines may be expeditiouſly produced, without *Fermentation*; *viz.* by *Maceration* and *Mixture*. And thus may numerous *Arts* and *chemical Proceſſes* be ſhortened, and rendered more advantageous, by dropping an intermediate Operation. And we cannot but wonder this Enquiry ſhould have been ſo remiſsly carried on in particular Arts, that ſeem more capable of being accelerated; eſpecially, as *Eſtates* might readily be raiſed, by making Commodities ſoon fit for the Market. The Buſineſs of *Acceleration* is therefore a capital Enquiry in *operative Philoſophy*; and deſerves to be proſecuted in all *Arts* and *Sciences*.

In *Taſtes*; the taking of a Potion, or Pills, cauſes the Head and the Neck to ſhudder. In *Smells*; the like Effect follows, tho leſs perceived, becauſe there is a Remedy at hand, by ſtopping the Noſe: but, in Horſes, that can uſe no ſuch help, the Smell of Carrion, eſpecially that of a dead Horſe, makes them fly away, and ſtart, as if they were mad. In *Feeling*; if a Perſon comes out of the Sun, ſuddenly into the Shade, there follows a Chilneſs, or ſmall ſhivering over all the Body. And, even in the *Sight*, which has no odious Object, coming into ſudden Darkneſs induces a kind of Shuddering [b].

AIR.

1. Great Diligence is required in the Choice of certain Bodies and Places, as it were, for taſting and trying of Air; to diſcover the wholeſomneſs or unwholeſomneſs, both of the Seaſons, and Seats for Habitation. There are ſome Houſes wherein Sweet-meats, and Pies, will grow mouldy ſooner than in others: and a Piece of raw Fleſh or Fiſh, will ſooner corrupt in ſome Airs than in others. They are noble Experiments that can aſſiſt in this Diſcovery; as affording a *Natural Divination* of Seaſons better than thoſe of Aſtronomers. And, again, they teach Men where to chuſe their Dwelling, for Health [c]. *The Trials to be made of Air.*

2. *'Tis reported*, That if Earth be taken up, adjoining to the River *Nile*, and preſerved from wet and waſte, it will not alter in weight till the 17th Day of *June*; which is the Day the River begins to riſe: but then grows more and more ponderous, till the River comes to its height. This, if true, muſt be *cauſed* by the *Air*; which then begins to condenſe; and ſo turns in the Mould to a degree of Moiſture, and produces weight. Tobacco cut, weigh'd, and dried by the Fire, loſes weight; and being laid in the open Air, recovers it again. And it ſhould ſeem, that as ſoon as the River begins to increaſe, the whole Body of the Air adjacent ſuffers a Change: for, *'tis affirmed*, that upon the very Day the River firſt riſes, great Plagues ſuddenly break out in *Cairo* [d]. *Whether Air may turn to Water.*

[b] 'Tis worth obſerving, how cloſely, and aphoriſtically, the Author traces Nature; and ſimply endeavours to expreſs the naked Fact, or Phænomena; all along laying the Foundation for a juſt *Interpretation*. And let not the Uſe of the Word *Spirit* be here objected to, till a better can be ſubſtituted; or till the Enquiry into the *Affections* be thoroughly purſued. See the Author's Enquiry into *Life and Death*; and that about *Rarity and Denſity*, with regard to *Animal Spirits*. It might here be added, that ſome particular Notes in Muſick, eſpecially on the Organ, cauſe the Body to ſhudder viſibly; and ſometimes the Seats in the Churches to tremble: that *martial Muſick* makes ſome turn pale, whilſt it cauſes the Heart and Pulſe to beat ſtronger, *&c.* But the Intention of our *Notes* is not to proſecute the Author's Deſign; only to give Intimations for farther *Enquiry*.

[c] It ſeems ſtrange, that this Enquiry ſhould not have been farther proſecuted; eſpecially, conſidering the Foundation laid for it in Mr. *Boyle's Memoirs for a general Hiſtory of the Air*. One Reaſon may be, the little Knowledge Men generally have of *chemical Bodies*: a proper Set whereof might, perhaps, be contrived for diſcovering the more conſiderable *Ingredients of the Atmoſphere*, in particular *Countries* and Places, with the ſame Certainty as we do thoſe of *Mineral Waters*.

[d] Mr. *Boyle* has ſeveral Conſiderations upon this Head: but perhaps the Fact itſelf is not ſufficiently verified; and, till it be, it were improper to produce a number of ſimilar Inſtances:

which

In what ſtate coldeſt.

3. Star-light, and bright moon-ſhiny Nights, are colder than cloudy Nights: the *Cauſe* may be the dryneſs and thinneſs of the Air, which thereby becomes more piercing and ſharp. For large Continents are colder than Iſlands. And tho the Moon may incline the Air to Moiſture; yet when it ſhines bright, it argues the Air to be dry. Cloſe Air is alſo warmer than open Air: for the *cauſe of Cold, is*, perhaps, *an expiration from the Earth*, which in open places is ſtronger; and Air, itſelf, if unaltered by that Expiration, is not without ſome ſecret degree of Heat; as 'tis not without ſome ſecret degree of Light: otherwiſe Cats and Owls could not ſee in the Night; but the Air then hath a little Light, proportionable to the viſual *Spirits* and *Organs* of thoſe Creatures [e].

Whether Air may be condenſed for Nouriſhment.

4. *Onions* will often ſhoot as they hang in a Room; ſo will *Orpin*, and the *greater Houſe-leek*, for two or three Years together; if the Root be wrapt in a Cloth beſmeared with Oil, once in half a Year: and the like is *reported* of the Stalks of Lillies. Theſe Plants ſeem to have a ſtrong, denſe and ſucculent Moiſture, not apt to exhale; and is thence capable of ſupplying the Sprout from the old Store, without the help of the Earth: and this ſprouting is chiefly found in the late Spring, or early Summer; which are the times of putting forth. We ſee alſo, that Stumps of Trees, lying out of the Ground, will ſprout for a Seaſon. But it is a noble Experiment, and of great Conſequence, to find whether theſe Bodies gain weight in ſprouting. For if not, then what they ſend out in the Sprout, they loſe in ſome other part; but if they increaſe in weight, then it ſhews that *the Air may be ſo condenſed, as to become a denſe Body* [f]: whereas the general Courſe and Period of Things, here above the Earth's Surface, is to rarify, and not condenſe. This wou'd alſo ſhew, that the Air may nouriſh; which is another matter of Conſequence. Note, that to try this, the Experiment of the Houſe-leek ſhou'd be made without oiling the Cloth; otherwiſe the Plant might receive Nouriſhment from the Oil [g].

ALTERA-

which kind of Procedure is apt to make Facts paſs for Truths, without being carefully examined. See *Proſper Alpinius*, *Johan. Varot*, &c. and compare them with Mr. *Boyle's Memoirs for a general Hiſtory of the Air.*

[e] What is the adequate Meaſure of Cold? The direct Senſes only determine of Cold and Heat for themſelves. Is the Fact ſtrictly and univerſally true; that bright Nights are colder than Cloudy ones? There ſometimes happen very ſharp miſty Nights. Is the cauſe of Cold covered? What Judgment can ſafely be form'd of the modern Mechanical Doctrine of Cold and Froſt? With what degree of certainty is *Rarefaction* made the Meaſure of Heat? How far can the Informations of the Thermometer be ſafely truſted? Are Thermometers arrived at their Perfection? How does the Moon incline the Air to Moiſture? Has Air any Light from within itſelf; not owing to the Sun and Stars? Theſe particulars ſhould be farther enquired into. See the Article COOLNESS, in this *Piece*: See alſo the Hiſtory of Winds, and Mr. *Boyle's Experimental Hiſtory of Cold.*

[f] A compariſon of this with Mr. *Hales's Vegetable Staticks*, may give us ſome Notion of the Author's Sagacity, and Foreſight into the Iſſues and Conſequences of Experiments unmade in his own Time.

[g] This is a capital Enquiry, and has been proſecuted by Mr. *Boyle*, and many of the *Members of the* Royal Society, the *French Academy*, and more particularly of late by Mr. *Hales*; ſo far as to ſhew that Air may be fixed, and condenſed into a ſolid nutrimental Subſtance. And may not then this Diſcovery admit of ſome very uſeful Applications, and farther Improvements?

ALTERATIONS.

1. There are many *great Alterations of Bodies*, beſides thoſe that tend to *Concoction* and *Maturation:* for whatever ſo alters a Body, that it returns no more to what it was, may be call'd a *great Alteration*; as when *Meat* is *boil'd*, *roaſted*, *fry'd*; *Bread* baked; *Cheeſe* made; *Charcoal* prepared [h], *&c.* But to apply *Philoſophical Notions* to *vulgar Terms*; or to ſay, where theſe Notions cannot be aptly reconcil'd, that there wants a Term for it, is but the *ſhift of Ignorance:* for Knowledge will always remain a wandring and indigeſted Thing, if it be no more than a mixture of a few obvious Notions, and not built upon a *ſufficient number of Inſtances*, well compared together [i]. *Great Alterations of Bodies, what.*

2. The Conſiſtences of Bodies are very various; denſe, rare; tangible, pneumatical; volatile, fix'd; determinate, indeterminate; hard, ſoft; cleaving, not cleaving; congealable, uncongealable; liquefiable, not liquefiable; fragile, tough; flexible, inflexible; tractile, intractile; porous, ſolid; equal and ſmooth; unequal, veiny and fibrous; with a grain; entire, *&c.* to refer all which to Heat, Cold, Moiſture, and Drought, is a fruitleſs *Speculation.*

ANIMALS.

1. The difference between *Male* and *Female*, in ſome Creatures, is not to be ſeen but in the parts of Generation: as in Horſes, Dogs, Doves, *&c.* But ſome Species of Creatures differ in Magnitude, and that variouſly; in moſt the Male is the greater; as in Man, Pheaſants, Peacocks, Turkeys, *&c.* but in ſome few, as Hawks, *&c.* the Female is the largeſt. Some differ in the Hair and Feathers, as to Quantity, Curl and Colour; thus *He*-Lions are Shaggy, and have large Mains; but the *She*-Lions are ſmooth like Cats. Bulls are criſper upon the Forehead than Cows. The Peacock, Pheaſant-cock, and Goldfinch-cock, have fine Colours; but the *Hens* not: and generally the Cock-birds have the faireſt Feathers. Some differ in particular Parts; as Bucks have Horns, Does none; Rams have Horns more wreath'd than Ewes; Cocks have large Combs and Spurs, Hens little or none; Boars have great Fangs; Sows much leſs; the Turkey-cock hath large ſwelling Gills, the Hen hath leſs; Men have generally deeper and ſtronger Voices *The difference in Male and Female Animals.*

[h] Are not theſe *great Alterations* of Bodies a kind of *Tranſmutations?* They have this Characteriſtick of Tranſmutations, that they are inconvertible, by any Art hitherto known, into the ſame Bodies again. To ſpeak the Truth; Men appear to have perplexed themſelves about the Terms *Alterations* and *Tranſmutations*; and imagined I know not what Myſteries, and Impoſſibilities in them: whereas in the Judgment of the Senſes, and even of an exact and thorough Scrutiny, many *natural* and *artificial Operations* are *Tranſmutations*; whatever difficulty there may be in conceiving the *Modus* of the Thing. And if this imaginary Difficulty were once got over, I am perſuaded many conſiderable Diſcoveries of Changes and Alterations in Bodies would be made publick; which are now concealed for fear of popular Odium, and Cenſure. See the *Articles*, CONCOCTION, GOLD, and TRANSMUTATION.

[i] See this proſecuted in the *Novum Organum*; paſſim.

than Women. Some differ in Faculty; as the Cocks among Singing-Birds are the beſt Singers.

Its Cauſe.

2. The chief *Cauſe* of all this, ſhou'd ſeem that the Males have more Heat and Strength than the Females; as appears from hence, that all young Male-creatures are like Females: and ſo are Eunuchs, and caſtrated Creatures of all kinds. Now Heat generally cauſes largeneſs of Growth, where there is Moiſture enough to work upon: but if any Creature has too much Heat in proportion to its Moiſture, there the Female is the larger; as in Hawks and Sparrows. And if the Heat be ballanced with the Moiſture, there is little difference to be ſeen between Male and Female; as in Horſes and Dogs. We ſee alſo, that the Horns of Oxen and Cows are uſually longer than of Bulls; which is cauſed by an abundance of Moiſture, in the former, and wanting in the Horns of the Bull. Again, Heat cauſeth Pilofity and Criſpation; and ſo likewiſe, Beards in Men. It alſo expels the finer Moiſture; which want of Heat cannot do; and hence the Beauty and Variety of Feathers in the Male Birds. Heat alſo cauſes many Excrefcences, and much ſolid matter; which want of Heat cannot do: and this is the cauſe of Horns, and their largeneſs; as likewiſe of the Combs and Spurs of Cocks, Gills of Turkey-Cocks, and Fangs of Boars. Again, Heat rarifies and dilates the Pipes and Organs of the Body, whence the deepneſs of the Voice in Men. And thus Heat may refine the Spirits, and cauſe the Cock-ſinging-Bird to excel the Hen [k].

Of the comparative magnitude of living Creatures.

3. There are *Fiſhes* larger than any *Beaſts*; as the *Whale* is much larger than the *Elephant*: and Beaſts are generally larger than Birds. *Fiſhes* living not in the Air, have not their Moiſture drawn and drained by the Sun: beſides, they in a manner reſt continually, and are ſupported by the Water; whereas Beaſts conſume with Motion and Labour. Beaſts are larger than Birds; perhaps becauſe they continue longer in the Womb than Birds, and there nouriſh and grow; whereas Birds, after the Egg is laid, receive no further Growth or Nouriſhment from the Female: for the ſitting does but vivify, not nouriſh [l].

ANNIHI-

[k] The Reader will all along obſerve, that the Author only makes Attempts for diſcovering the Cauſes of Things; and does not pretend to have found them. The *Diſcovery of Cauſes* is a particular Work; that was to be proſecuted by numerous, exact, and rigorous Enquiries, in the fourth Part of the INSTAURATION, according to the inductive Method laid down in the *Novum Organum*. The preſent Collection therefore of *Differences betwixt Male and Female Creatures*, is to be farther enlarged, examined, and proved; whether they proceed from *Heat*, or a certain original ſubtile difference in the Conformation of the Parts; or both, or any other auxiliary and concurrent Cauſes. See *Memoires de l'Academie Royale pour ſervir a l' Hiſtoire des Animaux.*

[l] Theſe ſhou'd be conſtrued noble Attempts towards laying a Foundation for the *phyſical Reaſons* of Things; tho, upon fuller Information, they were to be found erroneous, or not ſtrictly true. If the Reader has diligently peruſed the *de Augmentis Scientiarum*, & *Novum Organum*, he will have no farther occaſion to be told how the *Sylva Sylvarum* is to be underſtood; the purpoſes it was intended to anſwer; the uſes to be made of it; and the many improvements it muſt neceſſarily require.

ANNIHILATION.

'Tis certain, that Matter cannot be annihilated: for as it was the Work of Omnipotence to make ſomewhat out of nothing; ſo it requires the like Omnipotency to turn ſomewhat into nothing. It was therefore well ſaid by an obſcure Chemiſt; that *there is no ſurer way of working ſtrange Tranſmutations in Bodies, than by ſtrenuouſly endeavouring to reduce Bodies to nothing.* And herein is contained a great *Secret*, as to the *Preſervation of Bodies*; for if we can keep them from turning into Air, by excluding the Air from them; from going into the Bodies adjacent, by chuſing thoſe utterly heterogeneal; and laſtly from having any Circulation within themſelves; they can never change; tho in their Nature ever ſo periſhable. We ſee, how Flies, Spiders, *&c.* acquire a Sepulchre in Amber, more durable than the Monuments and Embalmings of Kings. And I ſuſpect the like of certain Bodies put into Quick-ſilver. But then they muſt be thin; as a Leaf, a piece of Paper or Parchment: for if they have a greater Thickneſs, they will alter within themſelves, tho they waſte not[m]. See the *Article* PRESERVATION.

The impoſſibility of Annihilation.

ATTRACTION.

1. The *Turkiſh* Bow ſhoots ſo forcibly, that an Arrow from it has pierced a Steel Target, or piece of Braſs, two Inches thick: but what is more ſtrange, the Arrow, tho headed with Wood, hath gone thro' a piece of Wood, eight Inches thick. And 'tis certain we formerly uſed in Sea-fight, certain ſhort Arrows, which they call'd *Sprights*, without any other Head, than Wood, ſharpened; and theſe diſcharged out of Muſkets, would go thro' the ſides of Ships, where a Bullet would not enter. *This depends upon one of the greateſt Secrets in Nature*; viz. that SIMILITUDE OF SUBSTANCE WILL CAUSE ATTRACTION, *where the Body is wholly freed from the Motion of Gravity:* for if that were away, Lead wou'd attract Lead, and Gold attract Gold, and Iron attract Iron, without the help of the Loadſtone. But this ſame Motion of Gravity, being a *mere Motion of the Matter*, and *having no affinity with the Form*, or Kind, deſtroys the other Motion; except itſelf be deſtroy'd by a violent Motion, as in theſe Inſtances of Arrows; for then the Motion of Attraction by Similitude of Subſtance begins to ſhew itſelf[n].

Attraction by ſimilitude of Subſtance, in Wood.

2. 'Tis

[m] There is ſomewhat of Moment couched in this Paragraph; eſpecially with regard to the Nature of Corruption, or Putrefaction. Nor is the Subject, tho it has paſſed thro' many Hands, well proſecuted. To acquire a Command over *Putrefaction*, in natural Bodies, wou'd be acquiring a capital Command: and yet the Foundation of the Enquiry is laid here.

[n] Is the *Fact* here delivered, well verified, and abſolutely aſcertained? It is a thing of that importance to *Phyſicks*, as to require the ſtricteſt Examination: and perhaps the whole of Chemiſtry depends upon this *Doctrine of Similitude*; where *Simile Simili gaudet* may paſs for an *Axiom*, deduced from numerous Experiments; and ſo well verified, as poſſibly to deſerve a place in the *Philoſophia Secunda*, or *ſixth Part* of the Author's INSTAURATION. Sir *Iſaac Newton*'s whole *Syſtem of Phyſicks* reſts upon the Principle of *Attraction*. See the *Note* upon the *Article* GLASS.

In Salt-Water. 2. *'Tis ſaid*, That *ſalt Water* will diſſolve *Salt* ſooner than freſh. The *Cauſe* may be; that the Salt in the Water, by Similitude of Subſtance attracts the Salt new put in; whereby it diffuſes in the Liquor more ſpeedily. This is a noble Experiment, *if true*; for it ſhews a Means of making more quick and eaſy Infuſions: and is likewiſe, a good *Inſtance* of *Attraction*, *by Similitude of Subſtance*. Try it with Sugar put into Water formerly ſugared, and in other Water unſugared [o].

Attraction in Sugar and Wine. 3. Put a Lump of Sugar to Wine, part above, and part under the Surface; and the Sugar above the Wine will ſoften and diſſolve ſooner than that within it [p]: the Wine entering the under part of the Sugar, by ſimple Infuſion, or ſpreading; whilſt the upper part is likewiſe affected by *Suction* [q]. For all ſpongy Bodies expel Air, and attract Liquor, if it be contiguous: as we ſee in a Sponge, with one part dipt in Water. 'Tis worth enquiring, how to make more accurate Infuſions by help of Attraction [r]. See the *Articles* ELECTRICITY, MAGNETISM, and SYMPATHY.

B.

BATHING.

The Uſe of Bathing and Anointing. 'TIS ſtrange that the Uſe of Bathing is dropt: with the *Romans* and the *Grecians* it was as uſual as eating or ſleeping; ſo 'tis among the *Turks* at this day; whilſt, with us, it remains but as a part of Medicine. *I gueſs*, the Uſe of it among the *Romans* was found hurtful; as, making the Body ſoft, and eaſy to waſte. For the *Turks* 'tis more proper, *becauſe* their drinking Water, and feeding upon Rice, and other Food of little Nouriſhment,

[o] Tho an Experiment may be ever ſo eaſily made, yet, thro' a ſtrange Indolence, the Generality had rather believe or disbelieve it, upon hearing, than riſe and try it. And till this indolent Temper be conquered, no wonder if *Experimental Philoſophy* languiſh; and our common Diſcourſes, and Books, continue full of nauſeous Repetitions of Facts, handed down from Age to Age unverified. Let this Experiment therefore be *tried* with care, by adding only a ſmall Proportion of Salt or Sugar to the Water at firſt; for every one knows, that when a Liquor is fully ſaturated with a Subſtance; it will diſſolve no more of that Subſtance, tho it may of another. There are ſome Experiments to this purpoſe in the *Philoſophical Tranſactions* and *French Memoirs*.

[p] This Experiment is eaſily tried.

[q] What was formerly attributed to Suction, is now, in great meaſure, found owing to Impulſe, or the Preſſure of the Air: and for that kind of Suction which happens in ſlender Glaſs Tubes plunged in Water, as well *in Vacuo* as in the open Air, 'tis now called by the Name of *Attraction*; with little difference as to the *Phænomenon*, or its *Cauſe*.

[r] What does the Author mean by making more accurate *Infuſions* by the help of Attraction? Perhaps he had a View to that Way which the Chemiſts call *per Deliquium*; where a Salt, or other Body, attracts the Moiſture of the Air, and runs into a Liquor with it. And this, in many caſes, is a better Method than that by diſſolving the Body in common Water. Thus Sugar, Salt of Tartar, *&c.* will relent and run by the moiſture of the Air, or by being ſuſpended over Water, *&c.* by which they imbibe the lighter and more ſubtile Particles of the Fluid: and if the brisk and ſprightly *Mineral Waters* contain any *material, liquid Spirit*; whereto their Virtue is owing; were not this a proper Expedient or Encheireſis for catching and detaining it, in a neutral Subſtance, as it naturally flies off at the Spring-head, or from the containing Veſſel?

ment, makes their Bodies ſo ſolid and hard, that Bathing cannot well ſoften them too much. Beſides, the *Turks* are great Sitters, and ſeldom walk; whence they ſweat leſs, and need bathing more: yet, Bathing, and eſpecially Anointing, may be ſo uſed as greatly to promote Health, and long Life [a]. See the *Article* SWEAT.

BIRTH.

The Means of accelerating Births.

The Births of living Creatures may be *accelerated* in two reſpects: the one, if the *Embryo* ripen and come to perfection ſooner; the other, if there be ſome CAUSES of Expulſion from the Mother's Body: the former is good, and argues Strength; but the latter bad, and proceeds by Accident, or Diſorder. Whence the antient Obſervation is true, that *a Child born in the ſeventh Month commonly does well; but born in the eighth Month generally dies.* For where there is ſo great an Anticipation of the ordinary Time, this ſeems owing to the ſtrength of the Child; but when the Anticipation is leſs, to ſome Indiſpoſition of the Mother [b].

BLACK-MOORS.

The Colour of Black and Tawny Moors.

The heat of the Sun *may* make Men black in ſome Countries; as in *Æthiopia*, *Guinea*, &c. Fire has not the ſame Effect; as we ſee in *Glaſs-Men*, who are continually about the Fire. Perhaps, Fire licks up and exhales the Spirits and Blood of the Body; whence it always makes Men look pale and ſallow; whilſt the Sun, which is a gentle Heat, only draws the Blood to the outward Parts; and rather concocts than drinks it up: whence all *Æthiops* are fleſhy, plump, and large lipped: which ſhews Moiſture retained, and not exhaled. We ſee alſo, that the *Negroes* are bred in Countries abounding with Water, by means of Rivers, or otherwiſe: for *Meroe*, the Metropolis of *Æthiopia*, ſtood upon a great Lake; and *Congo*, where the *Negroes* are, is full of Rivers; the Confines of the River *Niger*, where *Negroes* alſo abound, are well watered; and the Region of *Cape Verde* is peſtilent, thro' Moiſture: but the Countries of the *Abyſſenes*, *Barbary*, and *Peru*, where the Natives are tawny, olive-coloured, and pale, prove generally more ſandy and dry. And the *Æthiopians*, perhaps, are ſanguine and ruddy, if their *black Skins* would ſuffer it to be ſeen [c].

BLOOD.

[a] Some Attempts have of late been made to revive the ancient Practice of Bathing, tho rather the *cold* than the *warm* and temperate kind. See Sir *John Floyer*, and Dr. *Baynard* on the Subject. There can be little queſtion made of the Uſefulneſs of both kinds, when properly employ'd: but the Rules for applying them are not well deduced, and eſtabliſhed. Dr. *Hoffman* has ſet an Example for regulating the uſe of warm Bathing: ſee his Pieces upon *Mineral Waters*. But for the Subject of *Anointing*, it ſeems in a manner neglected; tho capable of great Improvement: as may, in ſome meaſure, appear by the Author's *Hiſtory of Life and Death*.

[b] This Paragraph may ſerve to direct the *Enquiry* into the proper Methods of *haſtening Delivery*.

[c] This ſhort Collection of Obſervations contains the Foundations of a noble *Enquiry*; the Cauſe of Blackneſs in the *Moors*: and leads directly up to the Diſcovery, that this Blackneſs is ſeated in the *Reticulum Muſoſum*. See *Malpighi*, *Ruyſh*, and the modern *Anatomiſts*.

BLOOD.

The Blood of the Cuttle-Fish black.

'Tis ſtrange, that the Blood of all Birds, Beaſts, and Fiſhes, ſhould be of a red Colour; and only the Blood of the *Cuttle* black, as Ink. One would think, this *proceeded* from the high *Concoction of the Blood*; for, we ſee, in the common Black-puddings, that boiling turns the Blood of them black: and the Cuttle-Fiſh is accounted fine eating [d].

BONES *and* TEETH.

Memoirs for the Enquiry of reſtoring Teeth in old Age.

1. To reſtore the Teeth in old Age were a capital Work. There are five kinds of hard Subſtances in animal Bodies; *viz.* (1.) Skull, (2.) Teeth, (3.) Bones, (4.) Horns, and, (5.) Nails. The greateſt Quantity of hard Subſtance, is ſeated towards the Head; for there are the Skull, the Teeth, the maxillary Bones, the *Oſſa Petroſa*, and the Horns; ſo that the Structure of animal Bodies, is like that of a Houſe; where the Walls, and other parts, have their Columns and Rafters; but the Roof is of Tile, Lead, or Stone. *Birds* have three other hard Subſtances; *viz.* (1.) the Bill, of like matter with the Teeth, for no Birds have Teeth. (2.) The Shell of the Egg. And, (3.) Quills: their *Spurs* being but as a Nail. No living Creatures that have hard Shells; as Oiſters, Cockles, Muſcles, the Tortoiſe, *&c.* have Bones within them, only ſmall Griſtles [e].

Obſervations.

(1.) *That bony Matter is plentifully ſupplied to the Head.*

(2.) *That Bones, at their Growth, do not waſte.*

2. *Bones*, after full Growth, continue at a ſtay; ſo does the Skull: but Horns, in ſome Creatures, are caſt and renewed. The *Teeth* ſtand at a ſtay, except their wearing: *Nails* grow continually; and *Bills* and *Beaks* will overgrow, and ſometimes be caſt; as in Eagles and Par rots.

(3.) *That bony Matter naturally goes to the Extremities.*

3. Moſt hard Subſtances go to the Extremities of the Body; as the Skull, Horns, Teeth, Nails, and Beaks: only the Bones are more inward, and clad with Fleſh. The Entrails are all without Bones, except that a Bone is ſometimes found in the Heart of a Stag; and, perhaps, ſome other Creatures [f].

(4.) *The Contents of the Bones.*

4. The *Skull* contains the Brain, as a kind of Marrow. The *Back-bone* holds a kind of Marrow, having an Affinity with the Brain; and the other Bones hold another kind. The *Jaw-bones* have no Marrow ſeparated, but a little pulpy Matter diffuſed in them. The *Teeth*, likewiſe, *are ſaid* to have a kind of *diffuſed Marrow*, which cauſes the Senſe and Pain of the Part; but 'tis rather a *Nerve:* for Marrow has no more Senſe than Blood [g]. *Horn* is alike throughout, and ſo are the *Nails.*

(5.) *The Teeth have Senſation.*

5. None of the hard Subſtances have Senſe [h] but the *Teeth*; and theſe have Senſe not only of Pain but of Cold [i]. The Teeth, in Men, are of three kinds;

[d] Is the black Juice of the *Cuttle-Fiſh*, the proper Blood of the Creature? Conſult the Naturaliſts.

[e] We have here a little Model of a *Natural Enquiry*, conducted in the regular Way, ſo as to exhibit a ſhort View, and Example, of the inductive *Method* laid down in the *Novum Organum.*

[f] Conſult the Naturaliſts; or, rather, Nature herſelf.

[g h] 'Tis eſteemed a modern Diſcovery, that the Marrow and Bones have no Senſation.

[i] *Viz.* By means of the Nerves that line their Cavities.

kinds; *viz.* (1.) Sharp, as the Fore-teeth; (2.) Broad, as the Back-teeth; which we call Ginders; and, (3.) Pointed, or *canine*; which are between both. But ſome have had their Teeth undivided; and conſiſting of one whole Bone, with a little Mark in the place of the Diviſion; as *Pyrrhus* had. (6.) *The Teeth in Men of three kinds.*

6. Some Creatures have over-long, out-growing Teeth, call'd Fangs, or Tuſks; as Boars, Pikes, Salmons, and Dogs. Some Creatures have Teeth againſt Teeth; as Men, and Horſes: and ſome have Teeth, eſpecially their Maſter-teeth, indented one within another, like Saws; as Lions, and Dogs. Some Fiſhes have divers Rows of Teeth in the Roofs of their Mouths; as Pikes, Salmons, Trouts, *&c.* and many more in ſalt Waters. *Vipers*, and other Serpents, have venomous Teeth; which are ſometimes miſtaken for their Sting [k]. (7.) *Some Creatures have out-growing Teeth.*

7. No horned Beaſt has upper Teeth [l]; and no Beaſt that has Teeth above wants them below: but tho the hard Matter be of the ſame kind, it is no conſequence, that becauſe this bony Matter does not go into upper Teeth, it muſt needs go into Horns; nor, *vice verſa:* for Does, that want Horns, have no *upper Teeth* [m]. (8.) *No horned Beaſt has upper Fore-teeth.*

8. Horſes, at three Years old, have a Tooth, which they call the *Colt's Tooth*; and, at four Years old, there comes the *Mark Tooth*; which has a Hole big enough to receive a Pea: and this Tooth wears ſhorter and ſhorter every Year; till, at eight Years old, the Tooth is ſmooth, and the Hole worn out; and then, they ſay, *the Mark is out of the Horſe's Mouth* [n]. (9.) *The Mark in Horſes Teeth.*

9. The Teeth, in Man, firſt breed at a year and half from the Birth; they are afterwards caſt, and new ones come about ſeven [o]: but many have Hind-teeth grow at twenty, and ſome at thirty or forty Years old. *Quære*, the manner of their coming [p]. *They ſay* of the old Counteſs of *Deſmond*, who lived to ſeven Score, that ſhe bred her Teeth twice or thrice; caſting her old ones, and others coming in their place. (10.) *The ſhedding and new growing of the Teeth.*

10. The *Teeth* are much damaged by Sweet meats [q]; painting with Mercury; by things over-hot, or over-cold; and by Rheums. And the Tooth-ach is one of the ſharpeſt of Pains. (11.) *How the Teeth are damaged.*

11. The following Particulars ſhould be conſidered; *viz.* (1.) The Means of preſerving the Teeth. (2.) The Ways of keeping of them White. (3.) The (12.) *Particular Enquiries about the* Teeth.

[k] It has been diſcovered, that the Teeth in Vipers, is not the ſeat of the Venom; but a particular Bag, that lies underneath the Tooth, in the Gum. See Dr. *Mead's Eſſays on Poiſons.*

[l] This muſt, I ſuppoſe, be meant of Fore-teeth only; for, even *Calves*, have upper Hind-teeth.

[m] *Viz.* Fore-teeth.

[n] See Mr. *Chambers's* Dictionary, under the Article *Horſe.*

[o] Do Children always caſt their Teeth? and, do the Teeth often grow even and regular, after once ſhedding?

[p] It ſeems to be uſually attended with ſome degree of Pain, Swelling, and Inflammation of the Gum: whilſt the Tooth, being large and broad, makes its way ſlowly; ſo as to be ſeveral Months, or perhaps Years, in cutting, and coming to a level with thoſe in the ſame Jaw.

[q] This is denied by ſome with regard to *Sugar*; tho they allow it true of *unwaſhed Raiſins.* Sugar is extremely penetrating in ſome caſes; but how ſtands the Fact, in reſpect of the Teeth?

(3.) The Ways of drawing of them with leaſt Pain. (4.) The Cure of the Tooth-ach. (5.) The Ways of fixing in artificial Teeth. (6.) And laſtly, The Ways of reſtoring Teeth in Old Age.

(13.) *That the Teeth may poſſibly be reſtored in* old Age.

12. The Inſtances that render the laſt Attempt probable, are, (1.) The late coming of the Teeth in ſome Perſons: (2.) The renewal of the Beaks in Birds, and Horns in Beaſts. Let trial therefore be made, *whether Horns may be procured in Beaſts that are not horned; and how*[r]? And whether the Head of a Deer, that by Age is more *ſpitted*, may be brought again to be more *branched*. For theſe Experiments, and the like, will ſhew, whether the Growth of ſuch hard Matter can be provoked by Art? It ſhould alſo be tried, whether Birds might not be made to have greater or longer Bills, or greater and longer Talons; by doing ſomething to them when young? And, whether Children may not have ſome Waſh, or the like, to make their Teeth grow better and ſtronger? *Coral* is uſed as a help to the Teeth of Children [s].

BUBBLES.

Of Bubbles, *and the Cauſe of the Sphericity of* Liquors.

Bubbles are *Air* within, and a fine Skin of *Water* without: where it ſeems ſomewhat ſtrange, that the Air ſhould riſe ſo ſwiftly, while it is in the body of the Water; and when it comes to the top, be ſtaid by ſo weak a Cover. But the ſwift aſcent of the Air, while under Water, is owing to a *Motion of Percuſſion* from the Water; whilſt itſelf deſcending, drives up the Air; and not to a *Motion of Levity* in the Air. In this common Experiment of producing Bubbles in Water; the Sphericity and Encloſure of the Bubble proceeds from the *Appetite of reſiſting Separation*, which Fluids have; tho in a leſs degree than Solids. This is alſo manifeſt in the little Looking-glaſſes, which Children make with Ruſhes and Spittle; and in the Caſtles of Bubbles, which they make by blowing into ſoapy Water [t]. We ſee it alſo in the Drippings of Spouts; which, if there be Water enough to follow, will draw themſelves into a ſmall thread, rather than diſcontinue; but if there be no other way left, they caſt themſelves into Rounds; which is the Figure that ſaves the Body moſt from Diſcontinuance: Whence alſo proceeds the Roundneſs of Bubbles, as well with regard to the Skin of Water, as the Air within; ſince the Air likewiſe, to avoid Diſcontinuance, throws itſelf into a round Figure.

[r] In order to this, let a previous Enquiry be made into the Nature of that the Chirurgeons call a *Callus*; which ſeems to proceed from a fluid Subſtance, ouzing thro' the Pores of a Bone, and concreting extremely hard upon the broken Part; ſo as to become a Cement, and add to the bony Matter, whereof the Part before conſiſted. This might eaſily be transferred, and practiſed upon the Skulls of hornleſs Animals; to try, if an artificial kind of Horns could not be thus procured. But I am ſenſible the propoſing of ſuch Experiments looks ridiculous to many; who, however, are willing to admit them, when fully verified.

[s] This Enquiry has, by no means, been duly proſecuted. Phyſicians and Chirurgeons ſeem to think it below their notice; and moſt Philoſophers are otherwiſe engaged. Tho, perhaps, they might deſerve as well of Mankind, by diſcovering particular Methods of making Life more eaſy, as by ranging the wider Fields of Science.

[t] The Author has ſeveral times apologized for, and ſhewn the Neceſſity of, obſerving the meaneſt and commoneſt Experiments, in order to a *Hiſtory of Nature and Art*.

Figure. And, for the ſmall Stop of the Air, before the Bubble burſts; it ſhews, that Air, of itſelf, has no great Appetite of aſcending [u].

BURIALS.

1. *Burials* in Earth, ſerve for the *Preſervation*, *Condenſation*, and *Induration* of Bodies. If *Condenſation*, or *Induration*, be intended; the Bodies may be buried ſo as for the Earth to touch them; as in making artificial Porcellane [v], *&c.* And the like may be done for *Conſervation*, if the Bodies are hard and ſolid; as Clay, Wood, *&c.* But if the Deſign be the *Preſervation* of ſoft and tender Bodies; we muſt either put them in Caſes, ſo that they may not touch the Earth, or elſe vault the Earth, ſo that it may hang over them; for if the Earth touch them, it will do more hurt by its putrefying Moiſture, than good by its virtual Cold; unleſs the Earth be very dry and ſandy. *Of burying Bodies in Earth.*

2. An *Orange*, a *Lemmon*, and an *Apple*, wrapt in a Linen Cloth, being buried for a Fortnight, four Foot deep in the Earth of a moiſt Place, and in a rainy Seaſon, came out no ways mouldy or rotten; but a little harder than they were, and otherwiſe freſh in their Colour; tho their Juice was ſomewhat flatted. But, by being buried for a Fortnight longer, they became putrefied. *Experiments on Fruit, by burying.*

3. A Bottle of Beer, and another of *Wine*, buried in like manner, became more lively, better taſted, and clearer. A Bottle of *Vinegar*, ſo buried, came out more lively, more odoriferous, and ſmelling almoſt like a Violet. And, after a Month, all the three came out as freſh and lively, if not better than at firſt. *On Liquors.*

4. It might be a profitable Experiment, to preſerve *Oranges*, *Lemmons*, and *Pomegranates*, till Summer; for their Price would then be greater. This might be done by putting them in a Pot, or Veſſel, well covered, that the moiſture of the Earth come not at them: or elſe by putting them in a Conſervatory of Snow [w]. And, in general, whoever would make *Experiments with Cold*, ſhould be provided of a *Conſervatory of Snow*; a *large Vault*, at leaſt twenty Foot under Ground; and a *deep Well* [x]. *Requiſites to the making Experiments by Cold.*

5. *There is a Tradition*, that *Pearls*, *Corals*, and *Turcois-ſtones*, which have loſt their Colour, may have it recovered, by burying them in the Earth; which is a thing of great Profit, *if true:* but upon trial of ſix Weeks, there followed no Effect [y]. It were proper to try it in a deep Well, or in a Conſervatory *Experiments of burying precious Stones, to recover their Luſtre.*

[u] This Subject has been re-conſidered by Mr. *Boyle*, Sir *Iſaac Newton*, and many more; tho, perhaps, without being carried much farther than it is here by the Author.

[v] Do they actually bury their Earth in *China*, for making their Porcellane? or, Is there any Neceſſity for burying it? Would not the bare *Trituration*, and *Waſhing* of a proper terreſtrial Matter ſuffice?

[w] But the Fruit muſt not be ſuffered to freeze: for that would ſpoil them, without a particular Remedy; as by thawing them in cold Water.

[x] See the Author's *New Atlantis*, and Mr. *Boyle's Hiſtory of Cold.*

[y] It is a ſerviceable and juſt Obſervation, that Experiments which fail of the End propoſed in making them, are no leſs *inſtructive* than thoſe that ſucceed.

ſervatory of Snow, where the Cold may be more conſtringent; ſo as to make the Bodies more compact, and reſplendent [z].

C.

CANTHARIDES.

Whence Cantharides *become corroſive.*

Antharides are bred from a Worm, or Caterpillar, peculiar to certain Fruit-trees; as the Fig, the Pine, and the wild Briar; which bear ſweet Fruit, having a kind of ſecret Pungency, or biting Sharpneſs: for the Fig-tree abounds with a ſweet and corroſive Milk; the Pine-apple has a Kernel that is pungent and abſterſive; and the Fruit of the Briar being eaten, *is ſaid* to make Children ſcabby [a]. No wonder, therefore, if Cantharides have a *corroſive Quality*; for all other Inſects are bred from a duller Matter. The Body of the *Cantharis* is bright coloured; and, *perhaps*, the delicate coloured Dragon-fly may have ſome corroſive Quality [b].

CATERPILLARS.

The breeding of Caterpillars.

Caterpillars are one of the commoneſt Worms, that feed on *Dew* and *Leaves*: we ſee infinite Numbers of them bred and nouriſhed upon Trees and Hedges; whereby the Leaves, are in great meaſure, conſumed. They breed chiefly in the Spring; becauſe then there is both Dew and Leaf: and commonly when the Eaſt-winds have blown much; on account of the Dryneſs of that Wind. For to all *Vivification upon Putrefaction*, 'tis requiſite the Matter be not too moiſt: and therefore they have Cobwebs about them; which is a Sign of a *ſlimy Dryneſs*. Green Caterpillars breed in the inward Parts of unblown Roſes, where the Dew ſticks: but the largeſt Caterpillars, and the greateſt Numbers, breed upon Cabbages; which have a fat Leaf, that is apt to putrefy. The *Caterpillar*, towards the end of Summer, turns to a *Butterfly*; or, perhaps, ſome other Fly. There is a *Caterpillar* that has a Fur or Down upon it, and ſeems to reſemble the Silk-worm [c]. See the *Articles* GENERATION and INSECTS. CA-

[z] This Enquiry of Burials ſeems to have been much neglected; particularly deep Burials, which might be properly recommended to Miners; and proſecuted in *Fermentations, Putrefactions, Digeſtions*, and certain other chemical Operations. The Advantages of Vaults, in compariſon of Cellars, are reckoned very conſiderable, with regard to fermented Liquors: What therefore would be the Conſequence of having deeper Vaults? The Air of different Places on the Surface of the Earth, produces different Effects in certain Caſes; as in Brewing, Dying, *&c.* How, therefore, would the ſame Operations be affected, or altered, in different Mines, abounding with different *Effluvia*, beſides Air of different Denſities?

[a] The Fact is, perhaps, not verified. And allowing that Scabbineſs enſued upon eating of Blackberries; let it be enquired, whether this proceed from eating the Fruit? or, from the little Inſects that uſualy ſwarm upon the Berries? and may poſſibly ſtick to the Skin of ſuch as handle them.

[b] How far the Food of a Creature may remain unaltered, or paſs unchanged into the Body of the Creature, is not hitherto aſcertained. The Enquiry is noble, and uſeful: but whoever would ſucceed in it, muſt, perhaps, have more than a bare mathematical and mechanical Knowledge; at leaſt, he ſhould alſo take into conſideration, the *Doctrine of Menſtruums*, or *Solvents*: for Liquors, capable of diſſolving and tranſmuting ſome things more than others, appear to abound in all animal Bodies.

[c] The *Natural Hiſtory* of the Caterpillar, may have been well proſecuted, as to the Changes and different Phænomena of the Creature; from the *Egg*, or *Aurelia* to its perfect State: but its

CATHARTICKS.

(1.) *The Foundation of the Enquiry into the Nature and Operation of* Purgatives.

1. The *Operation* of *Purgatives*, and the *Cauſes* thereof, have been thought a great Secret; and, according to the ſlothful manner of Men, referr'd to a hidden Property, a ſpecifick Virtue, and the like Shifts of Ignorance. The *Cauſes* of purging are ſeveral; all plain, and well ſupported by Experience[d]. The *firſt* is, that whatever cannot be overcome and digeſted, the Stomach either throws up by Vomit, or tranſmits to the Inteſtines; and by this Motion of Expulſion in the Stomach and Guts, other parts of the Body are moved to expel *by conſent*; for nothing is more frequent than *Motion of Conſent* in the human Body[e]. This Surcharge of the Stomach is cauſed, either by the *Quality* of the Medicine; or by its *Quantity*. The *Qualities* are three; *viz.* (1.) Extreme *Bitterneſs*; as in Aloes, Coloquintida, *&c.* (2.) *Loathſomneſs*, and a horrible Taſte; as in Agaric, black Hellebore, *&c.* And, (3.) A ſecret *Malignity*, that often does not appear much in Taſte; as in Scammony, Mechoacan, Antimony, *&c.* And obſerve, if any purging Medicine hath neither of the two firſt manifeſt Qualities, it is to be ſuſpected a kind of Poiſon; as working either by Corroſion, or by a ſecret Malignity, and Enmity to Nature: whence ſuch Medicines are warily to be prepared, and preſcribed. The Quantity of what is taken down, alſo cauſes *Purging*; as a great Quantity of new Milk from the Cow; and a great Quantity of Meat: for Surfeits often turn to Purgings, both upwards and downwards. Hence Purges generally operate two or three Hours after they are in the Stomach; which firſt makes trial, whether it can concoct them. And the like happens after Surfeits; or Milk taken in too great plenty.

The firſt Cauſe of purging Indigeſtibility.

(2.) *Vellication.*

2. A *ſecond* Cauſe is *Vellication* of the Orifices of the Parts, eſpecially of the Meſenteriac Veins. Thus *Salt*, or any ſuch thing, that is ſharp and biting, applied to the *Anus*, provokes the Part to expel; as the Smell of Muſtard provokes Sneezing; and any ſharp thing to the Eyes, provokes Tears. So that all Catharticks have a kind of twitching and biting; beſides the griping which proceeds from Wind. And if this Vellication be in a violent degree, it proves little other than *Corroſion*, or *Poiſon*; as ſometimes happens in *Antimony*; eſpecially if it be given to Bodies not replete with Humours: for, where Humours abound, theſe guard and defend the Parts.

(3.) *Attraction.*

3. The *third* Cauſe is *Attraction*: for *purging Medicines have a direct Force of Attraction*, like drawing Plaiſters in Chirurgery. And Betony, ſternutatory Powders, and the like, put up the Noſe, draw Phlegm and Water from the Head: and ſo Apophlegmatiſms, and Gargariſms, draw the Rheum down by the Palate. And by this Virtue, ſome Purgatives may attract one Humour,

its *philoſophical Hiſtory*, with regard to the Interpretation of Nature, and human Uſes has not, perhaps, been greatly regarded. There are, however, ſome curious Papers relating to this Subject, in the *Philoſophical Tranſactions* and *French Memoirs*. See alſo *Rhedi* of the *Generation of Inſects*.

[d] And we might add, rather *verified*, than *contradicted*, by later Obſervation.

[e] For the Differences of *Motions*, See the *Novum Organum*, Part II. Sect. II.

Humour, and ſome another, according to the *received Opinion*; as Rhubarb purges Choler; Sena, Melancholy; Agaric, Phlegm, *&c.* yet more or leſs, they draw promiſcuouſly [e]. Note alſo, that beſides a *Sympathy* between the *Purgative* and the *Humour*, ſome Medicines may draw one Humour more than another; becauſe ſome Medicines work quicker than others: thoſe that draw quick, draw only the light and fluid Humours; whilſt thoſe that draw ſlow, work upon the more tough and viſcous. Men muſt therefore beware how they take *Rhubarb*, and the like Medicines alone, familiarly; for ſuch things carry off only the lighteſt part of the Humours, and leave the remaining Maſs more obſtinate [f].

(4.) *Flatulency.* 4. The *fourth* Cauſe is *Flatulency*; for *Wind* in motion moves to Expulſion: and, in effect, all Purgatives have a *raw Spirit*, or *Wind*; which is the principal Cauſe of Tortion, and Griping, in the Stomach and Belly. And therefore moſt Catharticks loſe their Virtue by boiling; and, for that reaſon, are given chiefly in *Infuſion*, *Juice*, or *Powder* [g].

Compreſſion. 5. The *fifth* Cauſe is Compreſſion; as when Water is ſqueezed out of a Spunge. Thus the catching of Cold cauſes a Looſeneſs, by contracting the Skin and external Parts. Cold, likewiſe, cauſes Rheums and Defluxions from the Head: and ſome aſtringent Plaiſters ſqueeze out purulent Matter. This kind of Operation is not found in many Medicines. Myrobalanes have it; and, *perhaps*, Peach-bark: for this Virtue requires *Aſtriction*, but ſuch as is not grateful to the Body; *pleaſing Aſtriction* rather keeping in, than expelling the Humours: and therefore ſuch an *ungrateful Aſtriction* is found in the things of an harſh Taſte.

(6.) *Lubrication and Relaxation.* 6. The *ſixth* Cauſe is *Lubrication* and *Relaxation*; as appears in *emollient Medicines:* for example, Milk, Honey, Mallows, Pellitory of the Wall, *&c.* There is alſo a *ſecret Virtue of Relaxation in Cold:* for the Heat of the Body binds the Parts and Humours together, which Cold relaxes: as we ſee in *Urine*, Blood, and the like; which, when cold, break and diſſolve [h]. And by this kind of Relaxation, Fear looſens the Belly; becauſe the Heat retiring towards the Heart; the Inteſtines, and other Parts, are conſequently relaxed. In the ſame manner Fear cauſes trembling of the Nerves. And of this kind of Purgatives are ſome *Preparations of Mercury*.

(7.) *Abſterſion and Attenuation.* 7. The *ſeventh* Cauſe of *Purging* is *Abſterſion*, or Scouring, and Attenuation of the more viſcous Humours; rendering them more fluid, and *cutting between*

[e] Partly thro' a want of Attention, and partly thro' a fondneſs for Simplicity, and the Humour of accounting for Things upon ſome one ſingle Principle, this uſeful Doctrine of the Ancients is in danger of being laid aſide by the Moderns. But the Diſtinction here made by the Author, may reconcile all Parties, if they would but attend to Nature; and not indulge any particular Vanity in philoſophizing. See the *Medicinal Works of Dr. Frid. Hoffman.*

[f] Perhaps this *Deduction* is almoſt fitted for an *Axiom.*

[g] Both Apothecaries and Phyſicians may receive conſiderable Information from this beginning of an Enquiry in their own Way; and how much more, if it were duly proſecuted, extended, and transferred from Purgatives to *Alteratives, Cardiacs, Cephalics, Stomachics,* &c? See the *Article* INFUSIONS.

[h] Here ſeems to be an excellent *Foundation* laid, for that highly uſeful and important *Enquiry into the Effects of Cold and Heat on the Body, with regard to Health and Sickneſs*; tho almoſt overlooked by *Phyſicians.*

tween them and the Parts; as in the *nitrian Waters*; which waſh Linen eaſily. But this cutting muſt be effected by Sharpneſs, without Aſtriction; as in *Salt*, *Wormwood*, *Oxymel*, and the like.

8. There are Medicines that move by Stool, and not by Urine; ſome by Urine, and not by Stool. Thoſe that purge by Stool, are ſuch as enter little into the Meſenteriac Veins; but either at firſt are indigeſtible by the Stomach, and deſcend immediately to the Guts; or elſe are afterwards rejected by the Meſenteriac Veins, and ſo again turn downwards to the Guts: and of theſe two kinds moſt Purgatives are. But thoſe that operate by Urine, are ſuch as are well digeſted by the Stomach; and well received alſo by the Meſenteriac Veins, whence they reach as far as the Kidneys: and theſe Medicines being opening and penetrating, promote the Office of the *Liver*, in driving down the Serum of the Blood to the Kidneys [i]. For *Diureticks* do not work by *Rejection* and *Indigeſtion*, as *Solutives* do.

The difference betwixt Purgatives and Diureticks.

9. There are ſeveral Medicines, which taken in a greater quantity, move by Stool; and in a ſmaller by Urine: *& vice verſa*. Of the former ſort is Rhubarb. The Cauſe ſeems to be, that the Stomach in a ſmall quantity digeſts and overcomes Rhubarb; as being neither flatulent nor loathſome; and ſo ſends it into the Meſenteriac Veins; whence, being opening, it promotes Urine: but in a greater quantity, the Stomach cannot overcome it; and therefore it goes to the Inteſtines. *Pepper*, by ſome of the Ancients, is noted to be of the other kind; which taken in a ſmall Doſe, moves Wind in the Stomach and Guts, and ſo expels by Stool [k]; but in a greater quantity diſſipates Wind: and itſelf getting into the Meſenteriac Veins, thus paſſes to the *Liver and Kidneys*; where, by heating and opening, it provokes Urine in plenty [l].

That the ſame Medicine may be Purgative and Diuretick, in a larger or ſmaller Doſe.

CEMENTS.

1. There is a *Cement* compounded of Flower, the Whites of Eggs, and powdered Stone, that becomes hard as Marble; wherewith the *Piſcina Mirabilis*, near *Cuma*, is ſaid to have its Walls plaiſter'd. And 'tis found, that the Powder of Load-ſtone and Flint, made into Paſte, by the addition of Whites of Eggs and Gum-Dragon, will in a few Days acquire the Hardneſs of a Stone [m].

Plaiſter growing as hard as Marble.

2. Certain

[i] Has the *Liver* any Share in the Separation of the Urine?

[k] Is Pepper certainly found to be *Purgative*, in a large Doſe, and *Diuretick* in a ſmall one?

[l] Perhaps when this uſeful Enquiry comes to be duly proſecuted, and the method of Rejection and Verification practiſed upon it, there may be found ſome ſmall inaccuracies in what is here delivered; but the Doctrine, in general, ſeems the beſt that is extant; as following Nature cloſe, without giving into Opinion, Hypotheſis, or the vanity of any temporary Philoſophy. And if this Method were to be carefully purſued, by proper Perſons, for a few Years; cou'd any Man queſtion whether our preſent ſtate of Phyſick wou'd not be improved? But we ſeem to act as if we were not ſollicitous about the improvement of Medicine, or elſe deſpaired of it.

[m] *Cements* are uſeful Things in *Arts* and *practical Philoſophy*. Mr. *Boyle* mentions a few: but Operators generally keep them as Secrets. There is one made of a kind of Stone: barely by

Cements and Quarries growing hard in the Air.

2. Certain *Cements* have been found very ſoft under the Earth, yet harden in the Sun, to the degree of Marble: and there are ordinary Quarries in *Somerſetſhire*, which cut ſoft to any bigneſs; and in the Building prove firm and hard [n].

CHAMELEON.

Obſervations upon the Chameleon.

The Chameleon is a Creature about the ſize of an ordinary Lizard: his Head unproportionably big, and his Eyes large. He moves his Head without turning his Neck, (which is inflexible) as a Hog doth: his Back is crooked; his Skin ſpotted with little Tumours, leſs eminent nearer the Belly; his Tail ſlender and long: on each Foot he has five Toes; three on the out-ſide, and two on the inſide; his Tongue is of a great length in reſpect of his Body, and hollow at the end, which he will dart out to prey upon Flies. He is of a Green Colour; and a dusky Yellow, but brighter and whiter, towards the Belly; yet ſpotted with Blue, White and Red. If he be laid upon Green, the Green predominates; if upon Yellow, the Yellow predominates; but not ſo, if he be laid upon Blue, Red, or White; only the green Spots receive a more orient Luſtre: laid upon Black, he looketh all Black, tho not without a mixture of Green. He feeds not wholly upon Air; tho that may be his principal Suſtenance: For ſometimes he catches Flies. Yet thoſe who have kept Chameleons a whole Year together, cou'd never perceive them feed upon any thing, unleſs it were Air; and obſerved their Bellies ſwell, after they had ſwallowed down the Air, and cloſed their Jaws; which they commonly open againſt the Rays of the Sun [o].

CHARACTERS of MATTER.

The Appetites, Paſſions, and Characters of Bodies.

The differences of *preſſible* and *impreſſible*; *figurable* and not *figurable*; *mouldable* and not *mouldable*; *ſciſſible* and not *ſciſſible*; &c. are vulgar Notions, applied to the common Inſtruments and Uſes of Men; but all them Effects of ſome of the following *Cauſes*. (1.) The *yielding* or not *yielding* of Bodies, ſo as to ſhrink into a ſmaller ſpace, or preſerve their external Bulk, and not fly back. (2.) The ſtronger or weaker Appetite in Bodies to Continuity. (3.) The diſpoſition of Bodies to contract, or not to contract; to extend, or not extend. (4) The ſmall or great quantity of *pneumatical Spirit* in Bodies [p]. (5.) The Nature of the *pneumatical Spirit*, whether Native, or only

pulverizing and mixing it with Water, that immediately Cements broken *Glaſs*, and *China Ware* with great Strength; and fits them for Uſe. So likewiſe a very large Bottle, broken into ſeveral pieces, may thus be ſet together again, and render'd uſeful, in two or three Minutes; as I have ſeen.

[n] With regard to this Subject, it were proper to enquire into the ancient Method of treating Stone, for Amphitheatres, Obelisks, *&c.* and if a kind of *artificial Stone* cou'd not be uſefully introduced. See a late Pamphlet upon this Head. But let the ſimpleſt Methods be firſt followed. There is ſomething extraordinary to be found in *Gypſum*.

[o] Query, Whether any Information can be had from the Hiſtory of the Chameleon, for the Condenſation of *Air into Nutriment?* See the *Article* AIR.

[p] The Doctrine of *pneumatical Spirits* ſeems at preſent diſcountenanced; thro' an Affection of accounting for all Things, upon ſimple, general, and mechanical Principles. But if Men are

ly *common Air.* (6.) The Nature of the native Spirits in the Body, whether active and eager, or dull and gentle. (7.) The emiſſion or detention of the Spirits in Bodies. (8.) The dilatation or contraction of the Spirits in Bodies, while they are detained. (9.) The collocation of the Spirits in Bodies, whether equal or unequal; and whether the Spirits be collected or diffuſed. (10.) The denſity or rarity of the tangible Parts. (11.) The equality or inequality of the tangible Parts. (12.) The digeſtion or crudity of the tangible Parts. (13.) The nature of the Matter, whether *ſulphureous* or *mercurial*, *watry* or *oily*, *dry* and *terreſtrial*, or *moiſt* and *liquid:* For the *ſulphureous* and *mercurial Natures ſeem to be Radical, and Principal Natures* [q]. (14.) The placing of the tangible Parts, lengthwiſe or tranſverſe; more inward, or more outward, *&c.* (15.) The poroſity or cloſeneſs betwixt the tangible Parts, and the ſize of the Pores. (16.) The diſpoſition and poſition of the Pores [r].

CLARIFICATION.

1. Many *Liquors* are at firſt thick and turbid; as *Muſt*, *Wort*, expreſs'd *Juices of Fruits*, *Herbs*, &c. but ſettle and clarify by Time. To fine them *The Cauſes of Clarification in Liquors.*

are in earneſt; let them ſtrictly enquire, whether theſe *Spirits* have not an actual Exiſtence; and do not really perform many Operations, and produce many Effects in Nature? It muſt be obſerved that the word *pneumatical* does not ſignify *immaterial:* 'tis ſufficient to make a Thing pneumatical that it be as light as Air. And let due Enquiry be made, whether all *pneumatical Spirits* are not a Compoſition of Air, intermixed with the ſubtile parts of Bodies, under the Form of a fine Effluvium? What is it in the Kernel of a Nut that exhales thro' the Shell, and leaves the Kernel ſhrunk and withered? What occaſions ſtale Eggs to ſhrink from their Shell? How do violently purging and poiſonous Plants loſe their Virtue and Effect, and become innocent, by long keeping? What occaſions Exploſion in certain Chemical Operations; the ſwelling of Nitre in Diſtillation, *&c?* Let theſe Enquiries be purſued; and the Eye of the Underſtanding be kept ever fixed upon Nature.

[q] Whence the Author intended *particular Enquiries* into them.

[r] What Author has duly ſearched out the particular *Characters* and *Paſſions* of Matter? 'Tis a moſt extenſive part of Phyſicks, that remains to be derived from a cloſe inſpection of Natural Bodies; their different *Forms, Tendencies, Endeavours, Relations, Affections*, &c. For theſe are not hypothetical Things; nor to be idly reſolved into *Attraction*, and *Sympathy*, *mechanical Structure*, and partial Notions of Philoſophy: but to be inveſtigated, regiſter'd, and tabled. *Chemiſtry* has done ſomething towards it; but the Enquiry ſtops ſhort, and the Particulars have not been juſtly collected, marſhalled, and drawn into Tables for Uſe. The Lord *Bacon* ſeems to have directed his Natural Enquiries principally this way; but who has follow'd him? Some Attempt ſhould, at leaſt, be made; and the general Properties of Matter be carefully diſtinguiſhed from the particular. Are there not eight *general Properties of Matter*, common to all the Bodies in the Univerſe; *viz.* (1.) Extenſion; (2.) Impenetrability; (3.) Gravity; (4.) Figurability; (5.) Diviſibility; (6.) Motion; (7.) Reſt; and (8.) Communication of Motion? To theſe perhaps may be added; (9.) *Solidity*; and (10.) *Elaſticity*; as all Fluids are poſſibly *Solid* and *Elaſtick* in their minuteſt Particles. Theſe general Properties of Matter ſeem to have come under mathematical, rather than phyſical Conſideration. But the *particular Properties of Bodies* are not to be found by *Reaſoning*, *Mathematicks*, and the *general Laws of Motion*; but barely by diligent Experiment and Obſervation: ſuch as the Attraction betwixt Light and Bodies, Water and Salts, Metals and *Menſtruums*, *Gold* and *Quickſilver*, *Aqua Regia* and Gold, Spirit of Wine and *Roſins*, *Sulphur* and *Oils*, &c. 'Tis a careful Collection, and Arrangement, of theſe *particular Laws* of Bodies, that muſt let us into the *ſecret Operations of Nature*, and enable us to produce extraordinary Effects.

ſoon is a Capital Work; and a Spur to Nature, that makes her mend her pace: beſides, it is of conſiderable Uſe in making Drinks ſpeedily potable, and ſerviceable; but to diſcover the means of *accelerating the Operation*, we muſt previouſly know the *Cauſes* of *Clarification*.

Three Cauſes of Clarification.

2. The firſt Cauſe is, the *ſeparation of the groſſer Parts of the Liquor from the finer*. The ſecond, *the equal diſtribution of the Spirits of the Liquor among the tangible Parts: which always renders Bodies clear and untroubled.* And the third is the *refining of the Spirit itſelf*; *which thereby gives the Liquor more Splendor and Luſtre.*

Viz. (1.) *Separation.*

3. (1.) *Separation* is effected by weight, as in the ordinary ſettling of Liquors; by Heat, Motion, Precipitation, Sublimation, Adheſion, and Percolation. (2.) The *even diſtribution of the Spirits*, is effected by a gentle Heat; by Agitation, or Motion; the admixture of ſome other Body, which has a power to open the Liquor, and to make the Spirits paſs thro' it the better. (3.) The *refining of the Spirit*, is likewiſe effected by Heat; by Motion; and by the admixture of ſome Body, which has a power of attenuating.

(2.) *Diſtribution.*

(3.) *And the Refinement of the Spirit.*

Racking.

4. 'Tis a common practice to draw Wine, or Beer, from the Lees, which we call *Racking*; whereby the Liquor will clarify much ſooner: for the Lees, tho they keep the Drink in Heart, and make it laſting [r]; yet throw up ſome ſpiſſitude: and this *Inſtance* is referable to *Separation*. On the other hand, it were proper to try what will be the Conſequence of adding more Lees than its own to the Liquor; for *tho the Lees make the Liquor turbid, they refine the Spirits* [s]. Take, therefore, two Veſſels of new Beer; and rack the one from its Lees, and pour them into the unrack'd Veſſel; and ſee the Effect [t]. Put ſome quantity of ſtale Beer into new; and ſee whether it will not accelerate the Clarification, by opening the body of the Beer, and cutting the groſſer Parts, whereby they may fall down into the Lees [u].

Brewing.

5. The longer that Malt, Herbs, or the like are infuſed in the Liquor, the more thick and troubled the Liquor becomes; but the longer they are boiled in the Liquor, the clearer it proves [w]. The Reaſon ſeems plain; becauſe

[r] Do the Lees of fermented Liquors, *after ſome certain Time*, contribute ro keep the Liquor alive; and make it more durable? Or is it not better, as well in *Malt-Liquors*, as in *Wines*, to rack, after the *firſt Fermentation* is over?

[s] As Vintners find by *Experience*.

[t] The Fermentation will be in ſome meaſure renew'd; and the Liquor afterwards become fine again. It is a common Practice, when Wines prove thin and poor, or begin to fall off, to add the Lees of richer Wines to them; whereby a conſiderable degree of Melioration is procured.

[u] Is not this a frequent Practice among the *Brewers*, or rather their *Coopers*? And in order to ſave their ſtale Beer for more uſeful purpoſes, do they not employ *artificial Acids*, for fining their Drink, and giving it that harſhneſs, ſharpneſs, and ſtaleneſs of Taſte, which enhances its Price? The common Practices of Tradeſmen might conſiderably enrich our preſent *operative Philoſophy*.

[w] That is, *Decoction* makes a more thorough and intimate *Solution* than long continued *Infuſion*; where the Liquor is clogged with more Matter than it can incorporate, and hold *tranſparently diſſolved*, for want of Heat and Boiling.

because in *Infusion*, the longer the Operation continues, the more of the gross Body goes into the Liquor; but in *Decoction*, tho more of this gross Matter goes out, yet it either purges at the top, or settles to the bottom: and therefore the most exact way of Clarifying, is, first to *infuse*, and then to draw off the Liquor and *boil* it; as they do for Beer: where Malt is first infused in the Water, and the Infusion afterwards boiled with the Hop [x].

Experiments for clarifying by Heat and Motion, with regard to the even distribution and refining of the Spirits.

6. Put hot Embers about a Bottle, fill'd, almost to the neck, with new Beer: let the Bottle be well stopped; and renew the Embers every twenty four Hours, for ten Days; then compare it with another Bottle of the same Beer set apart [y]. Take also Lime, both slaked and unslaked, and set Bottles in it as above. Let other Bottles be swung, or carried in a Wheelbarrow, upon rough ground, twice a Day: but then the Bottles should not be quite filled; for if the Liquor come close to the Stopple, it cannot play, nor flower. And when they are thus well shook, pour the drink into another Bottle, stopped close, after the usual manner; for if it continue with much Air in it, the drink will grow flat; and not settle so perfectly in all its parts [z]. Let it stand twenty four Hours; then put it again into a Bottle with Air; and thence into a Bottle stopped, as above: and so repeat the Operation for seven Days. Note, that in emptying of one Bottle into another, you must be quick, left your drink pall. It were proper also to try this in a Bottle with a little Air below the Neck, without emptying.

7. With regard to *Percolation*, both *internal* and *external*, trial should be made of *clarifying by Adhesion*, as with Milk stirred into new Beer; for perhaps the grosser part of the Beer will cleave to the Milk: the doubt is, whether the Milk will separate again [a]. Also for the better clarifying by *Percolation*, when they tun new Beer, they pass it thro' a Strainer; and pro-

[x] Is not this a vulgar Error in Practice? And might not all the Trouble and Expence of boiling the *Wort* be saved; to the great advantage of the Liquor? What the Author here alledges may amount to this; that a rich *Decoction* of Malt ferments, and clarifies, better than a thin *Infusion*: but cou'd not an Infusion of Malt be made as rich as is necessary; and thus, tho it fermented not so violently, yielded not so many Lees, or threw not up so large a head, be much more readily fermented, and fined, or made into a wholsomer, thinner, and brighter Liquor, than by Decoction? The Experiment has been tried with Success.

[y] And if the Operation is well perform'd, the heated Liquor may become *Vinegar*; instead of clarifying and ripening in its own Form. But this Experiment is, perhaps, more instructive than if it were to have had the intended Success.

[z] It may belong to this Enquiry to examine, what Effects the *London* Drays have upon the Beer they carry thro' the Streets; and whether the Liquor is not thus shook to Advantage; after being *cleared off* as they call it; and now made to ferment afresh, with considerable Violence; so as afterwards to fall fine the sooner, and ripen better: which seems to be the Case. And after finding the Effects of Motion and Heat; let the Enquiry be directed to Rest, and Coolness, in the business of fermented Liquors: for both these seem to have a considerable share in Clarification; insomuch, that after the *first Fermentation* is over, it is a practice among the curious, to remove their Liquors into cool Cellars: and perhaps the Cellar now cannot be too cool, if defended from *Winds* and *Frost*.

[a] Milk, if thoroughly separated from its Cream, does not permanently unite with fermented Liquors, but usually curdles, and precipitates all their grosser Parts to the bottom: insomuch that a small addition of Milk perfectly well skimmed, will precipitate the Colour out of Red *Wine*, and leave it almost pellucid, like *Water*; tho without otherwise hurting the *Wine*.

bably the finer the Strainer is, the clearer the Liquor will become [b].

Clarification *by Almonds.*

8. In *Egypt*, they prepare, and clarify, the Water of the *Nile*, by putting it into great Stone Jars; and ſtirring it about, together with a few ſtamped Almonds, wherewith they alſo beſmear the mouth of the Veſſel; and after it has reſted ſome time, draw it off. It were proper to try this Method of clarifying with Almonds, in new Beer; or Muſt, to haſten the Clarification [c]. See the *Articles*, DRINKS, MATURATION, and PERCOLATION.

COLD.

The Production of Cold, a noble Enquiry.

1. The *Production of Cold* is a thing very worthy of Enquiry; both for *Uſe* and the *diſcovery of Cauſes* [d]. For *Heat* and *Cold* are the two Hands of Nature. *Heat*, we have in readineſs, from Fire; but for *Cold*, we muſt wait till it comes; or ſeek it in Caves or Mountains: and when all is done, we cannot obtain it in any great degree: for Furnaces are much hotter than the Summer's Sun; but Vaults, or Hills, not much colder than a Winter's Froſt.

The Cauſes or Means of producing Cold.

2. The *firſt* Means of producing Cold, is that of Nature, or the Expiration of it from the inward Parts of the Earth in Winter, when the Sun has no power to overcome it [e].

3. The *ſecond* Cauſe of Cold, is the Contact of cold Bodies; for Cold is active and tranſitive into Bodies adjacent, as well as Heat; as we ſee in thoſe Things that are touched with Snow, or cold Water. And therefore, whoever would fully enquire into Nature, muſt reſort to *Conſervatories of Snow and Ice*; ſuch as they uſe, for Delicacy, to cool Wine in Summer: which is a poor and contemptible Uſe, in reſpect of others that may be made of ſuch Conſervatories [f].

4. The *third* Cauſe is, the primary Nature of all tangible Bodies: for all tangible Things are of themſelves cold; unleſs they have an acceſſory heat by Fire, Life or Motion: even Spirit of Wine, and Chemical Oils, tho ſo hot in Operation, are to the Touch cold: and *Air* itſelf condenſed a little by blowing, is cold [g].

5. The

[b] No conſiderable Advantage can be well expected from external *Percolation* in clarifying fermented Liquors; as all Turbidneſs ſeems to proceed from a continuance, or renewal of their *Fermentation*: ſo that tho a turbid fermenting Liquor were paſſed thro' a *Paper Filtre*, or a *filtring Stone*, it preſently grows turbid again. Internal *Percolation* therefore, or Precipitation, as by whites of Eggs, skimmed Milk, *Iſing-glaſs*, &c. ſeems better adapted for the *Clarification* of theſe Liquors.

[c] The Vintners ſometimes make uſe of this Expedient: but are *Almonds* better for the purpoſe, than *skimmed Milk*; the *Whites of Eggs*; or *Iſing-glaſs*? There is alſo ſaid to be a certain Seed uſed upon the Coaſt of *Cormandal* and *Malabar*, for clarifying Water. See the *Philoſophical Tranſactions*, N° 249.

[d] Obſerve, what has been fully explained in the *Novum Organum*; that to diſcover the *Cauſes of Things*, is finding the *Means to produce them*, whence *Cauſes*, and the *Means of Production* are convertible Terms.

[e] What Inſtances are there to ſhew that Cold expires from the Earth?

[f] See the *Author's* NEW ATLANTIS, and Mr. *Boyle's Hiſtory of Cold.*

[g] See *Boerhaave's Chemiſtry*, under the Chapter of *Fire.*

5. The *fourth* Cauſe is Denſity; for all denſe Bodies, as Metals, Stone, Glaſs, are generally colder than others, and longer in heating than ſofter Bodies. But earthy, denſe, and tangible Bodies, are of the Nature of Cold. For all tangible Matter being cold; it follows, that where the Matter is moſt denſe, the Cold is the greater.

6. The *fifth* Cauſe of Cold, is a quick Spirit [h] incloſed in a cold Body; as appears from attentively conſidering Nature in many Inſtances. Thus, *Nitre*, which has a quick Spirit, is cold; and colder to the Tongue than a Stone: *Water* is colder than Oil, as having a quicker Spirit: *Snow* is colder than Water, becauſe it hath more Spirit: ſo Salt put to Ice, as in producing *artificial* Ice, increaſes the activity of Cold: ſo ſome Animals which have a quick *Spirit of Life*, as Snakes and Silk-worms, are cold to the Touch; and ſo Quickſilver is the coldeſt of Metals, becauſe fulleſt of Spirit.

7. The *ſixth* Cauſe, is the Expulſion of Spirits, that have ſome degree of Heat: for the baniſhing of Heat muſt needs leave a Body cold; as in the Operation of Opium, and Stupefactives, upon the Spirits of living Creatures.

8. *Seventhly*, the ſame Effect muſt follow upon the Exhalation of warm Spirits. *There is an Opinion* that the Moon is magnetical of Heat, as the Sun is of Cold and Moiſture: it were therefore not amiſs to try it with warm Waters; the one expos'd to the Rays of the Moon, the other with ſome ſkreen betwixt the Beams of the Moon and the Water; as we uſe to the Sun for Shade; thus to diſcover whether the former will cool ſooner. It were alſo proper to enquire, what other means there may be, to draw forth the ſmall degree of Heat which is in the Air; for that may be a ſecret of great Efficacy in producing cold Weather [i]. See the *Articles*, AIR, COOLNESS, and HEAT.

COLOURS.

1. Metals give beautiful orient Colours, in Diſſolution; Gold gives an excellent Yellow; Copper an excellent Green; Tin an excellent Azure. So likewiſe in their Calces or Ruſts; as in *Vermilion*, *Verdigreaſe*, *Ceruſe*, &c. and again, in their Vitrifications: for by their ſtrength of Body they endure the Fire, or *Aquæ fortes*, and are thereby put into an uniform Poſition, and ſtill *The Colours afforded by Metals.*

[h] This Introduction of Spirits has been already apologized for, and recommended to a particular Enquiry. See the *Article* AIR.

[i] This Enquiry is nobly proſecuted by Mr. *Boyle*; but the Subject is ſo fruitful, as not to be ſtill exhauſted; or the Cauſes of the Effect ſufficiently diſcovered: and till they are, *Practical Philoſophy* muſt needs remain imperfect. Nor were it eaſy to convince Men of the conſiderable Effects already produced by a proper application of Cold; as particularly in the freezing of *Wines*, and other ſpirituous, and ſaline Liquors. See the *Eſſay* lately publiſhed upon this Subject; entitled, *An Eſſay for Concentrating Wines, and other fermented Liquors; or taking all the ſuperfluous Water out of them to Advantage.*

ſtill retain part of their *principal Spirit* [k]; which two Particulars are chiefly required to make Colours bright and lightſome [l].

Of altering the Colour of Hair and Feathers.

2. Living Creatures generally change their Hair with Age, ſome earlier and ſome later; thus dappled Horſes turn white; old Squirrels griſly; *&c.* Cygnets turn from grey to white; Hawks from brown to white: and ſome Birds change their Colour upon Moulting; as the Robin-red breaſt, after Moulting, grows Red again by degrees: ſo do Gold-finches upon the Head. The Cauſe may be, that *Moiſture* chiefly colours Hair and Feathers; but *Dryneſs* turns them Grey and White: for Hair in Age grows drier; ſo do Feathers. But Feathers after Moulting, are young; or the ſame as the Feathers of young Birds. So the Beard being younger than the Hair of the Head, uſually grows Hoary later. Hence one might deviſe means of altering the Colours of Birds; and preventing Grey-hairs [m].

COMPRESSION.

The Compreſſion of Liquors.

It has been obſerved, that a large Veſſel of Liquor, being drawn out into Bottles; the Liquor returned into the Veſſel, would not fill the Veſſel again, ſo full as it was; and that this holds more in Wine than in Water. The Cauſe may be trivial; or the Liquors ſticking to the ſides of the Bottles: but, perhaps, alſo the Liquor in the Veſſel is not ſo much compreſs'd as in the Bottles; becauſe in the Veſſel it meets with Liquor chiefly; but in the Bottles a ſmall quantity of Liquor meets with a large Surface in the ſides of the Bottles, which may compreſs it ſo, that it ſhall not expand again [n].

CON-

[k] That *Metals* ſhould hold a *Spirit*, will ſound very odd to many. The Author produces ſeveral *Inſtances* for it. He does not however deſire we ſhou'd reſt in them; but recommends all to *further Enquiry*, and conſequent *Verification* or *Rejection*. See the *Articles*, FIXATION, HEAT, NATURE, and SPIRITS.

[l] Tho the buſineſs of Colours may ſeem to have been abundantly proſecuted, by ſeveral eminent Enquirers; yet there are many Particulars in it that require a farther diſcuſſion; eſpecially with regard to *Practice*: which is the thing that tries the Validity, the Perfection, and the Uſefulneſs of Diſcoveries. But ſeveral Arts depending upon Colours; as Painting, Dying, Callico-Printing, *&c.* are deficient in many particulars, for want of a thorough and commanding Knowledge in this Subject. Thus the making of *fixed and permanent mineral*, or *metalline Colours*, without *Acids* and *Alkalies*, is a Deſideratum; the foundation for ſupplying which, may ſeem here laid by the Author. It alſo deſerves a particular Enquiry, how the Buſineſs of Colours ſtands with the *Chineſe*.

[m] For a beginning to this Enquiry, See the Article TRANSMUTATION: but who has continued it?

[n] Has *quantity of Surface* a power of Compreſſing? Or what Force is capable of compreſſing Liquors? But for the *Phænomenon* itſelf, is not the principal Reaſon of it, the Exhalation of the more ſubtile Parts of the Liquor in the Operation; whilſt a ſlender Stream of the Liquor expoſes a large Surface to the Air, for a conſiderable Time? The Fact appears tolerably verified by the Experience of Vintners, and Diſtillers; particularly the latter, who find a conſiderable waſte of their high rectified Spirits, by meaſuring them out of one Veſſel into another: and no wonder, as Spirits evaporate faſter, and riſe much ſooner in Diſtillation than Water. And thus a Quantity of Proof-Brandy left in a Cup, expoſed to the Air for a few Days, will be reduced to Phlegm; and loſe half its original Quantity, which was chiefly *Spirit of Wine*.

CONCOCTION.

1. The Word *Concoction*, or *Digeſtion*, is chiefly taken from Obſervation upon living Creatures, and their Organs; and thence transferred to Liquors, Fruits, &c. Thus Men ſpeak of *Meat concocted*, *Urine* and *Excrements concocted*: and the four *Digeſtions*; viz. in the *Stomach*, *Liver*, *Arteries*, *Nerves*, or in the ſeveral Parts of the Body, are likewiſe called *Concoctions*: and all are made the Works of *Heat*. Theſe Notions are but ignorant Catches at a few things that lie more obvious to Mens Obſervation. The moſt conſtant Notion of *Concoction* is, to ſignify the degrees of Alteration of one Body into another, from *Crudity*, *to the ultimate Action*, or *Proceſs*, which is *perfect Concoction*. Whilſt a Body to be converted, is too ſtrong for the Efficient that ſhould convert it, that Body remains *crude* and *inconcocted*, and the Proceſs is to be called *Crudity* and *Inconcoction*. 'Tis true, *Concoction* is, in great part, the Work of Heat [p], but not of Heat alone; for all things that promote *Converſion*, as Reſt, Mixture of a Body already concocted, &c. are alſo means of *Concoction*. *Concoction and Crudity explained.*

2. There are two *Periods of Concoction*; the one *Aſſimilation*, or abſolute *Converſion*; the other, *Maturation*: the former is moſt conſpicuous in *Animal Bodies*; where there is an abſolute Converſion and Aſſimilation of the Nouriſhment into the Body: likewiſe in the Bodies of *Plants*; and again, in Metals; where there is a full *Tranſmutation*. The other, which is *Maturation*, appears in Liquors and Fruits; where there is not deſired, nor pretended, an utter *Converſion*; but only an *Alteration* to that Form, which is moſt proper for human Uſe; as in the clarifying of Drinks, ripening of Fruits, &c. *Two Periods of Concoction.*

3. But there are two kinds of *abſolute Converſions*. The one is, when a Body is converted into another before exiſting; as when Nouriſhment is turned into Fleſh; which we call *Aſſimilation*: the other, when the *Converſion* is into a new Body that did not præ-exiſt; as if *Silver* ſhould be turned into *Gold*, or *Iron* into *Copper*: and this *Converſion* is better, for Diſtinction ſake, called *Tranſmutation* [q]. See the *Article* ALTERATIONS. *Two kinds of abſolute Converſions.*

CONCRETION.

Concretions of Bodies are generally reſolved by the contrary Agent. Ice, which is Water congealed by Cold, is diſſolved by Heat: and Salt and Sugar, which are made by Heat and Dryneſs, are diſſolved by Cold and Moiſture. *The Cauſe of Concretion and Diſſolution in Bodies.*

The

[p] Are there not many *true Concoctions* performed without any *ſenſible Heat* at all? Let a particular regard, in this *Enquiry*, be had to *Menſtruums*.

[q] Tho not perhaps for the ſake of the Thing itſelf, and the Service of Philoſophy as by reaſon of an Abuſe of the Word; *Tranſmutations* are, indolently, reckoned *Impoſſibilities*. The Force of Diſtinctions in Philoſophy, is great. And thus to diſtinguiſh betwixt *Aſſimilatory*, and *Tranſmutatory* Operations, may prove eminently ſerviceable; as *Aſſimilations* are not denied: and as, perhaps, all the pretended *Tranſmutations* may come under *Aſſimilations*. But there are few who could bear to hear this Doctrine explained: and, perhaps, the beſt Explanations are *Works*, and *palpable Inſtances*.

The *Cauſe* is, that theſe Operations are rather *Returns* of the Bodies to their former Natures, than *Alterations:* whence the contrary Operations are the Cure. But *Oil* neither eaſily congeals with Cold, nor thickens with Heat; becauſe the *Spirit of the Oil* [r], by either means, exhales little: for Cold keeps it in; and Heat, unleſs vehement, does not call it forth. As for Cold, tho it take hold of the tangible Parts, yet it rather makes the *Spirits* ſwell, than congeals them; as when Ice is congealed in a Cup, it ſwells inſtead of contracting, and ſometimes breaks the Cup [s].

CONGELATION.

An Experiment for the Congealing of Water *into* Cryſtal.

'Tis credibly reported, that in deep Caves there are penſile Cryſtals, and degrees of Cryſtal, that drop from above; and, in ſome others, riſe from below [t]: and tho this be chiefly the Work of *Cold* [u], yet, perhaps, the Water that paſſes thro' the Earth, acquires a Nature more clammy, and fitter to congeal, and become ſolid, than Water of itſelf [v]. Therefore expoſe a heap of Earth [w], to violent Froſts, laid upon a hollow Veſſel; placing a Canvaſs between, to prevent the Earth from falling in: and pour Water upon it, in ſuch quantity as to ſoak thro'; and ſee whether it will not make a harder Congelation at the bottom of the Veſſel; and leſs apt to diſſolve than ordinary. I ſuppoſe alſo, that if the *Earth* be made narrower at the Bottom, than at the Top, in the Faſhion of a Sugar-loaf inverted, it will help the Experiment: as making the Ice leſs in Bulk, where it iſſues; for *Smallneſs of Quantity is a Help to Tranſmutation* [x].

CONTRACTION.

Whether Water will contract?

It is ſtrange, how the Ancients took Experiments upon Truſt; and yet built great Matters upon them. 'Tis confidently delivered, by ſome of their beſt Writers, that a Veſſel filled with Aſhes, will ſtill receive the ſame Quantity of Water it would have done without the Aſhes. But this is *utterly falſe*; for the Water will not go in by a fifth Part: which, I ſuppoſe, is the Quantity of Difference between the Aſhes lying cloſe, and looſe: for Aſhes alone, if hard preſſed, lie cloſer; but with Air between them, looſer; and, with Water, cloſer again. For I have not certainly

[r] The Author continually proceeds upon the Exiſtence of *Spirits*, in all kinds of Bodies: it were therefore proper, for general Satisfaction, and the ſure Diſcovery of the Truth, that a particular Enquiry were inſtituted about the *Spirits of Bodies*. The firſt Heads for ſuch a Hiſtory might eaſily be drawn out; but who will proſecute and fill them up?

[s] This has been thought a late Diſcovery.

[t] *M. Tournefort* has a remarkable Paper to this Purpoſe in the *French Memoirs*.

[u] Is Cryſtallization the Work of Cold, or not rather of Temperature, ſomewhat inclining to Coolneſs? Let Nature, and Experience, be conſulted.

[v] This Conjecture ſeems derived from Experience, or, at leaſt, comports well with it. See *Stahl's Principles of Chemiſtry:* and make trial of earthy Waters; or ſuch as have paſſed thro' *Lime-ſtone*, &c.

[w] Let the Earth be not *Mould*; but *calcarious*. And have we not a *natural Inſtance* of the thing in ſome old Walls; where Water ſtraining thro' the Mortar, becomes a hard concreted Subſtance? Let Enquiry be made into the *Nitrum Murale*, or *Calcarious Nitre* of Dr. *Liſter*.

[x] This perhaps might deſerve to paſs for an *Axiom*.

certainly found, that Water will contract, by being mixed with Aſhes, or Duſt [y].

COOLNESS.

Ways of gathering Wind for Freſhneſs.

'Tis practiſed in *Gaza*, as a Contrivance for Coolneſs in great Heats, to bed Veſſels of Earth in the Walls of their Houſes, to gather Wind from the Top, and convey it down, thro' Spouts, into the Rooms. And, 'tis ſaid, there are ſome Rooms, in *Italy* and *Spain*, for Freſhneſs, and gathering the Wind in the Heats of Summer: but theſe are Ways of penning in the Wind, and ſetting it looſe again; ſo as to make it reverberate, and go round in a Circle; rather than the former Device, of Spouts in the Wall [z].

CORAL.

The Growth of Coral.

In the Sea, to the Southweſt of *Sicily*, is found plenty of Coral. 'Tis a ſubmarine Plant, that hath no Leaves: it branches, only, when under Water; 'tis ſoft, and of a green Colour; but being brought into the Air, becomes hard, and ſhining red. 'Tis alſo ſaid to have a white Berry; but we find not the Berry brought over with the Coral. Perhaps 'tis caſt away as uſeleſs. *Enquire better of it, to diſcover the Nature of the Plant* [a].

D.

DEFORMITY.

Obſervations relating to Shaping the Body, and preventing Deformity.

IT *is reported*, that if Whelps, or other young Creatures, be put into a Box, this prevents their growth in Height, and makes them increaſe in Breadth or Length; as they have room: *if this be practicable*, and the Creature, ſo preſſed, ſurvives the Operation; it may be a means of producing dwarf Animals of a very ſtrange Figure. This is certain, that Preſſure, or Moulding the Parts of Creatures, whilſt they are very young, conſiderably alters their Shapes: as ſtroking the Heads of Infants was noted of old to make the *Macrocephali*; a long ſhaped Head being at that time in eſteem: and the raiſing, gently, the Bridge of the Noſe, prevents the Deformity of a Saddle-noſe. Which Obſervation, well conſidered, may teach a Method of making the Bodies of Men and Women, in many reſpects, more comely, and regular, than they would otherwiſe be; *viz.* by

[y] What is the *Fact*, with regard to the Contraction, or Dilatation of Liquors, upon the Addition of dry Bodies to them, that either diſſolve, or remain undiſſolved therein? If an Ounce of Sugar were diſſolved in a Pint of Water, how much higher will the Water riſe in a hollow graduated Cylinder? There ſeems to be ſome Subtilty in this Affair, not yet clearly comprehended; perhaps for want of juſtly diſtinguiſhing betwixt *Continuity* and *Contiguity*, *Mixture*, *Solution*, *Aggregation*, and *Texture*. See Dr. *Stahl* upon the Subject. See alſo, an Experiment to this purpoſe in the *Philoſophical Tranſactions*, Numb. 331. where two Liquors are ſhewn to poſſeſs leſs Space upon mixing.

[z] See more to this purpoſe in the Author's *Hiſtory of Winds*.

[a] Particularly conſult Mr. *Boyle*, and Count *Marſigli*, upon this Head.

Forming and Moulding them in Infancy: as by ſtroking up the Calves of the Legs, to keep them from falling too low; and by ſtroking up the Forehead, to keep it from ſinking [b]. It is a common Practice to ſwathe Infants, that they may grow better ſhaped; and, young Women, by wearing ſtreight Stays, keep themſelves from being groſs and corpulent [c].

DIVINATION.

An Enquiry begun, into natural Divination and Diſcovery.

1. All Bodies have *Perception*, tho, not *Senſe*: for when one Body is applied to another, there enſues a kind of Election, either to embrace, or expel [d]; and whether the Body be alterant, or altered, *Perception conſtantly precedes Operation*; otherwiſe all Bodies would be alike [e]. And this *Perception*, in ſome kind of Bodies, is ſo exquiſite, that the *Senſe* is dull, in compariſon of it. Thus the Thermometer will ſhew a minute Difference of Heat, or Cold, which the human Feeling cannot diſcover. And this *Perception* appears ſometimes at a Diſtance, as well as upon Touch: for Example, when the Loadſtone attracts Iron; or Flame the *Naphtha* of *Babylon*, afar off [f]. It were, therefore, a noble Enquiry *to diſcover the more ſubtile Perceptions of Bodies*; *for this would prove another Key to open Nature*, as well as the Senſe does; and ſometimes better [g]. Beſides, 'tis a principal Means of NATURAL DIVINATION; for what appears early, in theſe Preceptions, follows long after in great Effects. It will alſo ſerve to diſcover what is hid, as well as to foretel what is to come. Thus the *Senſe* cannot inform us, whether Seeds be old or new; but upon the Experiment of ſteeping them in Water, the new ones will ſprout ſooner. So the *Taſte* cannot diſcover the beſt Water; but the quick Evaporation of it in Boiling, and many other Experiments, will diſcover it. So in *Phyſiognomy*, the Lineaments of the Body

[b] Let Enquiry be made, whether inveterate Diſtempers, ariſing from an ill Conformation of the Parts, have not been cured by dry Friction, or Stroking. Has not a *Straitneſs of the Cheſt*, and a *Relaxation of the Uvula*, been helped by this means? Have not extraordinary Cures in Chirurgery been made by proper Bandages, and Rolling? Inſtances of this kind ſhould be collected, as primary Parts of the Enquiry, that ſhew the Power of Art, and tend to increaſe it; for what has once been done, may be done again.

[c] Men can never expect to know what may be done in this Way, without a careful Enquiry into the Subject; and diſcovering prudent, rational, and effectual Methods for putting the thing in practice. But we ſeem to dread the Enquiry; as if childiſhly afraid of acquiring and exerting a Power over Nature. Till this Charm is broke, we muſt take our Bodies as the Nurſe is pleaſed to ſwaddle and faſhion them.

[d] Is this meant of the general *Law of Attraction and Repulſion* in Bodies, or rather of particular Relations betwixt particular Bodies?

[e] This is an important Obſervation, and requires to be thoroughly verified, extended, and enriched, by all the eminent Inſtances that can any way be collected.

[f] Is this Tradition of the *Naphtha* verified? If more Inſtances are wanted, obſerve the Snuff of a Candle newly blown out, and applied near to the Flame of another Candle: the Catching of *Spirit of Wine*, Oil of Turpentine, Calico, *&c.* upon the approach of Flame; the near approach of two Drops of Water upon an Oil-cloth; of two Particles of Quickſilver upon a Board, *&c.* But a more eminent Inſtance of this kind, is ſeen in the *Attraction of Glaſs*, which will operate to the Diſtance of many Yards, by the help of Friction and a proper String; as Mr. *Steven Gray* has lately ſhewn.

[g] It cannot, perhaps, be too much obſerved, that the View of the Author is, not only to enquire himſelf, but more directly to ſet Mankind upon enquiring.

Body will diſcover thoſe *natural Inclinations* of the Mind, which Diſſimulation may conceal, or Diſcipline ſuppreſs [h]. *Divination*, indeed, is attained by other Means; ſo that if we know the Cauſes, and the Concomitants, we may judge of the Effect to follow; and the like may be ſaid of Diſcovery: but we here chiefly conſider that *Divination* and *Diſcovery*, which is to be had from an early or ſubtile *Perception*.

Attempts towards predicting the Wholeſomeneſs or Unwholeſomeneſs of Seaſons, and Places.

2. The Tendency of *Air*, or *Water*, to corrupt or putrefy, may doubtleſs be found, before it breaks out into manifeſt Effects; as the producing Diſeaſes, Blaſts, or the like. Great and early Heats in the Spring, without Winds, portend a peſtilential Seaſon; and, generally, ſo do Years with little Wind or Thunder. Great Droughts in Summer, laſting to the end of *Auguſt*, and ſome gentle Showers upon them, and then dry Weather again, portend a peſtilential Summer, the Year following; for, about the end of *Auguſt*, the Sweetneſs of the Earth, which goes into Plants and Trees [i], is exhaled; ſo that nothing then can breathe from the Earth, but a groſs Vapour; which is apt to corrupt the Air: and this Vapour, by the firſt Showers, if gentle, is releaſed, and comes forth abundantly. Whence thoſe who go out into the Air, ſoon after ſuch Showers, are often taken ſick; and, in *Africa*, they do not ſtir out of Doors ſoon after the firſt Showers. But if the firſt Showers prove violent, they rather waſh and fill the Earth, than ſuffer it to breathe forth preſently. And if dry Weather return, this fixes and continues the Corruption of the Air, begun upon the firſt Showers, and makes it unwholeſome, even to the next Summer: unleſs a very froſty Winter diſcharge it; which ſeldom ſucceeds ſuch Droughts. The leſſer Infections of the *Small-Pox*, *Purple Fevers*, *Agues*, &c. in the preceding Summer, and hovering all the Winter, portend a great Peſtilence the following Summer; for Putrefaction riſes not to its Height at once. It were proper, to lay a Piece of raw Fleſh, or Fiſh, in the open Air; and if the Matter putrefy quickly, it may be accounted a Sign of a Diſpoſition in the Air to Putrefaction. But, to be informed whether the Putrefaction is quick, or ſlow, compare this Experiment with the like made in another Year. It were alſo proper, in the ſame Year, and at the ſame time, to lay one Piece of Fleſh in the open Air; and another of the ſame kind and ſize within Doors: for if there be a general Diſpoſition in the Air to Putrefaction, probably, the Fleſh will ſooner putrefy abroad, where the Air has more power; than in the Houſe, where it has leſs. And this Experiment ſhould be made about the end of *March*; that Seaſon being likelieſt to diſcover what the Winter has done, and what the following Summer will do, upon the Air. And becauſe the

[h] Men do not, perhaps, ſufficiently conſider how few capital Diſcoveries can be made in Nature by the direct Uſe of the *Senſes*. Certainly the unaſſiſted Senſes reach not below the Surface of Things: but *Experiments* go deep, and as the Author expreſſes it, enter the Boſom of Nature. See the *Preliminaries* to the *Augmentis Scientiarum*, Sect. II. 5——10; and the *Novum Organum*, paſſim.

[i] Does an *actual Sweetneſs* aſcend from the Earth into Vegetables? or, are the Juices of the Earth converted, and rendered ſweet, by the Operation they undergo in *Plants*, *Flowers*, and *Fruits*?

Air receives a great Tincture and Infusion from the Earth, it were proper to try the Experiment, both upon a Pillar, or Pole of Wood, some height in the Air; and upon the Earth's Surface. Try whether *May-dew* will putrefy quickly, or no; for that, likewise, may disclose the Quality of the Air, and Vapour of the Earth. A dry *March* and a dry *May*, portend a healthful Summer; if there be a showery *April* between: otherwise, 'tis a Sign of a pestilential Year [k].

Directions to try the Air of Places.

3. To discover the *Disposition of the Air*, is of still more Use for the choice of *dwelling-Places*; at least, for Lodges, on account of Health. And, in this case, 'tis proper to make trial, not only of the Aptness of the Air to corrupt; but also of its Moisture, Dryness, and Temper, as to Heat or Cold. In some Houses Sugar will relent, and baked Meats grow mouldy, sooner than in others; and the Wainscots will also sweat in some more than in others, so as almost to run with Water: all which are chiefly caused by the Moisture of the Air. To examine this Matter: before a House is built, expose Wool, or a Sponge, in the place you would try; and comparing it with other Places, see whether the Substance exposed does not grow moist, or gain in weight; and judge of the place accordingly. So in some Places, either from the Nature of the Earth, or the Situation of Woods and Hills, the Air is more unequal than in others: and, as Inequality of Air is an Enemy to Health; set two similar Thermometers in different Places, the same Hours of the same Day, where no Shade nor Enclosures are; and mark to what height the Liquors rise; and if you find them rise unequally, conclude the place where the Liquor rises highest to be the warm Air, and the other the colder; and this in proportion to the Difference [l].

Attempts for predicting cold Winters, and hot Summers.

4. The *Means of predicting cold and long Winters*, and *hot and dry Summers*, should likewise be sought; as well for the Discovery of the *Causes*, as with regard to *Provisions*. (1.) If Wainscot, or Stone, that uses to sweat, be drier in the beginning of Winter, or the Eaves of Houses drop more slowly than ordinary; it portends a hard and frosty Winter: for it shews an Inclination of the Air to dry Weather; which, in Winter, is always joined with Frost. (2.) Generally, a moist and cool Summer portends a hard Winter; because the Vapours of the Earth not being dissipated by the Sun, in the Summer, they rebound upon the Winter [m]. (3.) A hot and dry Summer and Autumn, especially if the Heat and Drought extend far into *September*, portends an open beginning of Winter; and Cold to succeed,

[k] This Enquiry has been little prosecuted; tho Dr. *Sydenham*, and Mr. *Boyle*, have done somewhat in it. There seems still wanting, a competent Set of Observations upon the Weather, the Meteors, and the various Phænomena, Changes, and Revolutions in the Atmosphere; with a direct View to the Causes thereof. For so long as we remain ignorant of *Causes*, we can never safely predict, and govern *Effects*. Whence the principal Endeavours of the Author, in this Piece, are justly directed to the *Investigation of Causes*; so far as they are knowable.

[l] This Subject has been prosecuted, in some degree, by particular Persons; but not with that Variety of Experiments the Thing requires. See Mr. *Boyle's Memoirs for a general History of the Air.*

[m] How does this agree with what was just before observed, That Dryness occasions a hard Winter?

ſucceed, towards the latter part of the Winter, and the beginning of the Spring: for till then, the former Heat and Drought preſide; and the Vapours are not ſufficiently multiplied. (4.) A warm, open Winter, portends a hot and dry Summer; for the Vapours diſperſe into the Winter Showers: whereas Cold and Froſt keep them in, and convey them to the late Spring, and following Summer. (5.) Birds that change Countries at certain Seaſons, if they come early, ſhew the Temper of the Weather, according to the Country whence they came: as the Winter-Birds; *viz.* Woodcocks, Feldfares, *&c.* if they come early, and out of the Northern Countries, with us, ſhew cold Winters. But, in the ſame Country, Birds ſhew a Temper of Seaſon, like to that wherein they come; ſo Swallows, Bats, Cuckoos, *&c.* which appear towards Summer, if they come early, ſhew a hot Summer to follow [a].

5. The more *immediate Prognoſticks of Weather, to follow ſoon after*, are more certain than thoſe of Seaſons. The Reſounding of the Sea upon the Shore; and the Murmur of Winds in the Woods, without apparent Wind; ſhew Wind to follow: for ſuch Winds breathing chiefly out of the Earth, are not, at the firſt, perceived, unleſs pent up by Water or Woods; and therefore a Murmur out of Caves, likewiſe, portends the ſame. The upper Regions of the Air, *perceive* the Collection of the Matter of Tempeſts and Winds, before the Air below: and therefore the Obſcuration of the ſmaller Stars, is a Sign of a Tempeſt. Great Mountains *perceive* the Diſpoſition of the Air to Tempeſts, ſooner than the Valleys, or Plains below: hence, they ſay in *Wales*, that when certain Hills have their Night-caps on, they fore-bode Miſchief. The *Cauſe* may be, that Tempeſts, which are commonly bred above, in the middle Region, as they call it, are ſooneſt perceived to collect in the places near it. The *Air* and *Fire* have *ſubtile Perceptions* of a riſing Wind, before Men find it. The Trembling of a Candle will diſcover a Wind, that, otherwiſe, we feel not; and the Curvature of Flame, ſhews the Air beginning to fluctuate: and ſo do Fire-coals, by caſting off the Aſhes more than uſual. The *Cauſe may be*, that no Wind is at firſt, till it hath ſtruck and driven the Air, apparent to the Senſe; but Flame is eaſier to move than Air: and for the Aſhes, no wonder if an unperceived Wind ſhould ſhake them off; ſince we commonly try which way the Wind blows, by throwing Graſs or Chaff, or ſuch light things, into the Air [o].

The Prognoſticks of Weather near at hand; taken,
(1.) *From above.*

(2.) *From Fire and Air.*

6. When *Wind breathes from under the Sea*, as it cauſes a Reſounding of the Water, ſo it does ſome light Motion of Bubbles, and white Circles of Froth: for the Wind cannot be perceived by the Senſe, till there is an Eruption of a great Quantity from under the Water, ſo as to collect into a Body: whereas, at firſt, it comes but in ſmall Portions. And any light thing

(3.) *From the Sea.*

[a] Should it not be carefully obſerved, for a Series of Years, what degree of Truth and Certainty there is in theſe kind of Aphoriſms, in order to their being made *Rules* and *Canons?*

[o] Theſe kind of Obſervations lay a Foundation for diſcovering, as it were, the premeditated Acts of Nature, from ſlight Intimations; and may, doubtleſs, be carried to a great length, if Men will not be wanting to themſelves.

thing that moves, when we find no Wind, ſhews a Wind at hand; as when Feathers, or the Down of Thiſtles fly about in the Air.

(4.) *From Animals.* 7. As for *Prognoſticks of Weather from Animals*, let it be noted, that Creatures living in the open Air, muſt needs receive a quicker Impreſſion from the Air than Men, who dwell chiefly within Doors: and eſpecially Birds, that live in the freeſt, and cleareſt Air; and are apteſt, by their Voice, to tell what they find; and likewiſe expreſs it by the Motion of their Flight. *Water-Fowls*; as *Sea-gulls*, *Moor-hens*, &c. when they flock, and fly together from the Sea towards the Shores; and *Land-Birds*; as Crows, Swallows, *&c.* when they fly from the Land to Water, and beat the Waters with their Wings; fore-ſhew Rain and Wind. The *Cauſe* may be, the Pleaſure that both Kinds take in the Moiſture and Denſity of the Air; thence deſiring to be in Motion, and upon the Wing, whitherſoever they would otherwiſe go: for, no wonder, if Water-Fowl delight moſt in that Air which comes neareſt to Water: and many Land-Birds, alſo, delight in Water, and a moiſt Air. For the ſame Reaſon alſo, many Birds prune their Feathers; Geeſe gaggle; and Crows ſeem to call upon Rain: all which is expreſſing the Pleaſure they ſeem to receive in the relenting of the Air. The *Heron*, when ſhe ſoars high, ſhews Winds: but *Kites*, flying aloft, ſhew fair and dry Weather. The *Cauſe* may be, that they both mount moſt into the Air of that Temper wherein they moſt delight. The *Heron*, being a Water-Fowl, takes pleaſure in denſe Air; and being but heavy of Wing, requires the help of the groſſer Air. But the *Kite* affects not ſo much the Groſſneſs of the Air, as its Coldneſs and Freſhneſs; for being a Bird of Prey, and therefore hot, ſhe delights in the freſh Air, and often flies againſt the Wind; as *Trouts* and *Salmons* ſwim againſt the Stream. Yet all Birds may find Eaſe in high Air; as Swimmers do in deep Water: for, when aloft, they ſuſtain themſelves by the ſpread of their Wings, without Motion.

(5.) *Birds.*

(6.) *Fiſhes.* 8. *Fiſhes*; when they play towards the Top of the Water, commonly foretel Rain. The *Cauſe* may be, that a Fiſh hating Dryneſs, will not approach the Air till it grows moiſt; and when 'tis dry will avoid it, and ſwim lower.

(7.) *Beaſts.* 9. *Beaſts* generally delight in a moiſt Air; which makes them feed the better: whence, Sheep will go early in the Morning to feed againſt Rain. Cattle, Deer, and Rabbits, alſo feed hard before Rain: and a Heifer will toſs up her Noſe, and ſnuff in the Air againſt Rain.

(8.) *Plants.* 9. *Trefoil* ſwells in the Stalk againſt Rain, and ſo ſtands more upright; for, by wet, the Stalks of Plants riſe up, and the Leaves bow down. A ſmall red Flower grows in the Stubble-fields, and called by the Country People *Wincopipe*; which, if it open in the Morning, a fair Day is ſure to follow [p].

10. Even

[p] What is the Botanical Name and Nature of this Flower? If it afford any ſuch certain Indication of the Weather, it may be worth enquiring after. There are ſeveral late Inventions for diſcovering the Moiſture of the Air; as by ſuſpending a Sponge at one End of a Balance; with Weights in a Scale at the oppoſite End: the expoſing of ſtrong Oil of Vitriol to

10. Even in *Men*; Aches, Hurts, and Corns, are more ſenſible either towards Rain, or Froſt: the one cauſing the Humours to abound; and the other making them ſharper: whence both Extremes will bring the Gout. (9.) *Men.*

11. *Worms*, *Vermin*, &c. alſo foreſhew Wet: for Earth-worms will creep out, Moles caſt up, and Flies bite more, againſt Rain. (10.) *Worms, and Vermin.*

12. Solid Bodies alſo fore-ſhew Rain; as Stones and Wainſcot, when they ſweat: and Boxes, and wooden Pegs, when they draw out and wind hard; tho the former be but from an external Cauſe; the Stone or Wainſcot, turning and beating back the Air againſt itſelf: but the latter proceeds from an internal Swelling in the Body of the Wood [q]. See the *Articles* WEATHER and WINDS. (11.) *Solid Bodies.*

DRINKS.

They have in *Turkey*, and the *Eaſt*, certain Confections called *Serbets*, which are like candid Conſerves, and made of Sugar and Lemmons, Sugar and Citrons, or Sugar and Violets, and ſome other Flowers, with a Mixture of Ambergreeſe, for the more delicate: and by diſſolving theſe in Water, they make their Drinks [r]; being forbid the Uſe of *Wine* by their Law. But it may ſeem ſtrange, that no *Engliſhman*, *Dutchman*, or *German*, ſhould ſet up Brewing in *Conſtantinople*; conſidering the *Turks* have ſuch a Quantity of Barly. Frugality might, indeed, recommend the drinking of Water, to the Generality; but the Better-ſort might well be at the Expence of Malt-Liquor. This want of Malt-Liquor among the *Turks*, however, is the leſs to be wondered at, becauſe *France*, *Italy*, and *Spain*, have not yet given into the Uſe of Beer or Ale; which, perhaps, if they did, would mend both their Health and their Complexions [s]. 'Tis likely to be a profitable Attempt to any one who ſhould begin Brewing in *Turkey* [t]. See the *Articles* CLARIFICATION, and MATURATION. *The* Turkiſh *Drinks.*

DRUN-

to the Air: the fixing of a Wheat-beard, to move like the Index of a Dial, *&c.* But what do they really indicate with regard to the actual Change of Weather? Do they not rather denote the proportionable Quantity of Moiſture in the Air?

[q] Moſt of theſe Particulars are put into the Road of a proper Enquiry, and Examination, in the Author's *Hiſtory of Winds*; and till that Hiſtory be duly proſecuted, and the true Interpretation of Nature purſued, but little Preciſion can be rationally expected in the Subject. See Mr. *Boyle's Philoſophical Pieces*, the *Philoſophical Tranſactions*, the *French Memoirs*, &c. But it is of a greater Importance to conſult Nature herſelf; and procure better Information from careful *Obſervations*: which are to be ranged and ordered, according to the Directions of the *Novum Organum*.

[r] 'Tis not eaſy to be credited, without Trial, how pleaſant a Liquor may be made in this Way; and, by an eaſy Encheireſis, how nearly approaching to the fineſt Wines.

[s] We find it in the Nature of Men to extol ſome one thing above all others; and this frequently to a degree of Superſtition and Bigotry. Thus ſome write Panegyricks upon *Water*; ſome upon *Wine*; and ſome upon *Malt-Liquors*; to the Diſparagement of the reſt. But who enquires ſoberly into theſe Things; and gives to each its juſt ſhare of Merit? Have not all the Liquors their proper Uſes, under due Regulation? And may not *Water*, in ſome Caſes, be juſtly preferred to *Malt-Liquors*; Malt-Liquors to *Wine*, and *vice verſa*? Surely theſe things deſerve to be ſettled by Experience and Reaſon; and ſhould not be left fluctuating at every one's Caprice.

[t] For the *Turks* might be glad of any Pretext to indulge themſelves in ſpirituous Liquors, that could not well be conſtrued *Wine*, or the Juice of the Grape.

DRUNKENNESS.

Drunken Men unprolifick.

1. 'Tis generally allowed, that the Sperm of drunken Men is unfruitful: the *Cauſe* may be, that 'tis over-moiſtened, and wants Spiſſitude [u]. And we have a merry Saying, *That they who go drunk to Bed, beget Daughters.*

The Phænomena of Drunkenneſs, with Conjectures at their Cauſes.

2. Drunken Men are taken with a Defect in voluntary Motion; they reel, they tremble, they cannot ſtand, nor ſpeak, ſtrongly: becauſe the *Spirits* of the Wine oppreſs the *animal Spirits*, occupy part of their place, and ſo make them weak, and leſs able to move. Hence drunken Men are apt to fall aſleep: and Opiates and Stupefactives induce a kind of Drunkenneſs, by the *groſſneſs of their Vapour*; as Wine does by its *quantity of Vapour*. Beſides, they rob the *animal Spirits* of the Matter whereby they are nouriſhed: for the Spirits of the Wine prey upon this Matter, as well as the animal Spirits do: and thus make the animal Spirits leſs apt for Motion.

3. Drunken Men, (1.) imagine all turns round; and (2.) that external things are coming upon them; (3.) they do not well diſcern Objects afar off; and (4.) thoſe they ſee near at hand, they ſee out of their places; and (5.) ſometimes double. (1.) *They imagine that Things turn round*; becauſe the Spirits themſelves turn; being compreſs'd by the Vapour of the Wine: for all Fluids turn upon Compreſſion; and it is the ſame to the Sight, whether the viſual Spirits move, or the Object, or the Medium. And long turning round, cauſes the ſame Imagination. (2.) *Things ſeem to come upon them*, becauſe the viſual Spirits themſelves draw back; which makes the Object appear to come forwards: beſides, when they ſee Things turn round, and move, Fear makes them think they are coming upon them. (3.) *The Cauſe that they cannot ſee Things afar off*, is the weakneſs of the Spirits; for in every *Vertigo*, there is a Darkneſs, join'd with a ſemblance of turning round; as appears alſo in the lighter ſort of Swoonings. (4.) The *Cauſe of ſeeing Things out of their places*, is the Refraction of the viſual Spirits: for the Vapour is as an unequal Medium, and gives the Sight of Things out of place, as in Water. (5.) The *Cauſe of ſeeing Things double*, is the ſwift Motion of the Spirits: for the Motion of the viſual Spirits, and the Motion of the Object, make the ſame appearance; and for the ſwift Motion of the Object, if a muſical String be vibrated, it appears double or treble.

How Drunkenneſs is ſooner cauſed, and prevented.

4. (1.) Men are ſooner drunk with ſmall Draughts, than with larger: And, (2.) Again, Wine ſugar'd inebriates leſs than pure Wine. (1.) The Cauſe of the *former* is, that the Wine deſcends not ſo faſt to the bottom of the Stomach, but ſtays longer in the upper Part, and ſends Vapours faſter to the Head; and conſequently inebriates ſooner. For the ſame reaſon, Sops in Wine, quantity for quantity, inebriate more than Wine itſelf [v]. (2.) The Cauſe of the *ſecond* Caſe, is, that Sugar inſpiſſates the Spirits, and makes

[u] How is the Fact?

[v] It ſhould alſo be examined, whether the *Sop* does not imbibe more of the Spirit of the Wine, in proportion, than of its other Parts. This is eaſily tried by Diſtillation.

makes them not ſo eaſily reſolvable into Vapour [w]. Nay, 'tis thought ſome Remedy againſt Drunkenneſs, to drink ſugar'd Wine after pure Wine. And the ſame effect is wrought, either by *Oil*, or *Milk*, taken upon hard drinking [x].

DUCTILITY.

The Phænomena and Nature of ductile and tenſile Bodies.

All ductile and tenſile Bodies, as Metals, that will draw into Wire; and *Wool* and *Tow*, that will draw into Yarn or Thread; have a ſtrong reſiſtance to Diſcontinuity; which makes them follow the Force that draws them; without forſaking their own Body [y]. Viſcous Bodies likewiſe, as Pitch, Wax, Bird-lime, &c. will draw and rope. But the difference between *fibrous Bodies* and *viſcous Bodies*, is plain; for all Wool, Tow, Cotton, and Silk, have, beſides their Appetite of Continuance, with reſpect to the tenuity of their Thread, a deſire of Moiſture; and by Moiſture to join and incorporate with other Thread, eſpecially by means of a little wreathing. And *Gold* or *Silver Thread*, cannot be made without twiſting [z]. See the *Article* HARDNESS.

DYING.

Of the Scarlet Dye.

There is in ſome places, particularly in *Cephalenia*, a little Shrub call'd *Holly-Oak*, or *Dwarf-Oak*; upon the Leaves whereof riſes a Tumour like a Bliſter; which they gather, and rub out of it a certain red Duſt, that turns to Worms; theſe they kill with Wine, when they begin to quicken: and with this Duſt they dye Scarlet [a].

E.

ECHOES.

The ſuperreflection of Echoes.

IN the City *Ticinum* in *Italy*, is a Church that hath Windows only from above. 'Tis in Length a hundred Feet, in Breadth twenty, and in Height near fifty; having a Door in the middle. It reflects the Voice twelve or thirteen Times, if you ſtand cloſe by the end of the Wall, over againſt the

[w] The Operation of *Sugar* upon *inflammable Spirits*, by bare Digeſtion, or Solution, ſeems to be little conſider'd. There may be a valuable Secret in it.

[x] Theſe Facts may require to be better verified; but ſome danger attends the drinking of Milk upon Wine: eſpecially if the Wine be tart; or any acid Humour lodge in the Stomach, as there frequently does: for it might thus produce a hard Curd in the Stomach; and prove mortal; as it appears to have done in ſome Inſtances. But the Experiment with Oil is both ſafer, and probably more ſucceſsful. Underſtand the ſame of a Glaſs of Vinegar.

[y] It deſerves to be obſerved both in the preſent, and all other Caſes, how ſollicitous the Author is to expreſs the naked Phænomena, real Appearance, or preciſe Natures of Things; without any help of Imagination: and let not the words *Appetite*, *Reſiſtance*, *Diſcontinuance*, &c. be rejected, ſo long as they expreſs no more than appears.

[z] See the late Calculations of the Ductility of Gold, &c. by Mr. *Boyle*, Dr. *Halley*, &c.

[a] There is a Paper to this purpoſe in the *Philoſophical Tranſactions*, N° 40. See alſo the *French Memoirs*, An. 1711. *Sur une nouvelle Pourpre.*

Door. The Echo fades and dies by little and little, as at *Pont-Charenton* [b]. And the Voice ſounds, as if it came from above the Door. If you ſtand at the lower end, or on either ſide of the Door, the Echo holds; but not if you ſtand at the Door, or in the middle, juſt oppoſite to it. Note, that all Echoes ſound better againſt old Walls than new; becauſe the old are more dry and hollow. See the Article SOUNDS.

ELECTRICITY.

The Bodies that are Electrical.

1. The following Bodies are Electrical [c]. *Amber*, *Jet*, *Diamond*, *Sapphire*, *Opal*, *Amethyſt*, *Briſtol-Stone*, *Cryſtal*, *Clear Glaſs*, *Glaſs of Antimony*, various *metalline Fluores*, *Talc*, *Sulphur*, *Maſtic*, hard *Sealing-Wax*, hard *Roſin*, and *Arſenick* [d].

The Bodies that are not Electrical.

2. The following Bodies are not Electrical. *Emerald*, *Agate*, *Cornelian*, *Pearl*, *Jaſper*, *Chalcedony*, *Alabaſter*, *Porphyry*, *Coral*, *Marble*, *Touch-Stone*, *Blood-Stone*, *Emery*, *Ivory*, *Bone*, *Ebony*, *Cedar*, *Cypreſs*, *Pitch*, *ſoft Roſin*, *Camphire*, *Galbanum*, *Ammoniacum*, *Storax*, *Benjamin*, *Loadſtone*, *Aſphaltum*.

3. *Gold*, *Silver*, *Braſs and Iron*, are not Electrical, tho ever ſo finely poliſh'd.

Sal-gem, *Roch Alum*, and the *Lapis Specularis*, will attract in the Winter, if the Air be ſharp and clear.

The Bodies diſpoſed to be attracted.

4. The following Bodies are apt to be attracted, if the Maſs of them is ſmall; viz. Chaff, Wood, Leaves, Stones, all the Metals, in Leaf and in Ore; Earth, Water, Oil.

Leading Experiments made with electrical Bodies.

5. If a Needle be made of any Metal, and placed after the manner of the *magnetick Needle*, and a Lump of Amber, gently rubbed, be applied to one end thereof, the Needle will turn [e].

6. Amber, heated before the Fire, whether to a degree of warmth, ſcorching, or inflammability, will not attract.

7. A red-hot Bar of Iron, Flame, a burning Candle, or an ignited Coal, being applied to light Bodies, or poiſed Needles, will not attract them.

8. If Amber be in a great Lump, and poliſh'd, it will attract, without rubbing; but if the Lump be ſmall or dirty, it requires Friction to make it attractive.

9. Cryſtal, Talc, Glaſs, and other electrical Bodies, do not attract if burnt, or conſiderably heated.

10. Pitch, ſoft Roſin, Benjamin, Aſphaltum, Camphire, Galbanum, Ammoniacum, Storax, and Aſſa fœtida, have no attractive Virtue in warm Weather, but in cold a ſmall one.

11. Moiſt Air blown upon Amber, or other electrical Bodies, either by the Mouth, or otherwiſe, ſtifles their attractive Virtue.

12. If

[b] For an account of the Echo at *Pont-Charenton*, ſee the Article SOUNDS.

[c] Here ſeem to be collected the firſt Elements of an Enquiry into Electricity.

[d] Might not more be added to the Number? See Dr. *Plot*'s Catalogue of Electrical Bodies, in the *Philoſophical Tranſactions*, N° 245.

[e] Is this well verified?

12. If Paper, or Linen, be ſpread between Amber, and light, chaffy Matters, there enſues no Motion, nor Attraction.

13. Amber, and other electrical Bodies, are not excited to Attraction by receiving the Sun's Rays, as they are by Friction.

14. Amber being rubbed, and expoſed to the Sun's Rays, retains its attractive Virtue the longer; or loſes it not ſo ſoon as if it had ſtood in the Shade.

15. Heat procured to Amber, and other electrical Bodies, by a burning Concave, does not increaſe their attractive Virtue.

16. Burning Sulphur, and flaming Sealing-wax, have no attractive Virtue.

17. Amber attracts beſt when applied to light Bodies, or poiſed Needles, immediately after Friction.

18. The electrical Virtue continues as ſtrong, for a ſmall time, as at the firſt.

19. Flame is not attracted by Amber, applied within the Sphere of its Activity.

20. A Drop of Water is drawn up into a Cone, upon the Application of Amber.

21. If electrical Bodies be rubbed too hard, it hinders their attracting.

22. Such electrical Bodies as ſcarcely attract in clear Weather, have no Virtue at all when the Air is thick and cloudy.

23. Water thrown upon Amber ſtifles its attractive Virtue; tho Water itſelf is attracted by Amber.

24. *Sarca*[f] ſo ſurrounded by Amber as to touch it, attracts; but not at all, if the Amber be interpoſed without touching.

25. Oil, applied to Amber, does not hinder its Virtue; nor deſtroy it tho rubbed on with the Finger.

26. Amber, Jet, and the like Bodies, have a ſtrong electrical Virtue, and retain it long, tho excited with a ſmall degree of Friction: but Diamond, Cryſtal, and Glaſs, muſt be long rubbed; ſo as to grow manifeſtly hot, before they will attract.

27. Amber, tho near applied, will not attract ſuch Bodies as are cloſe to Flame.

28. Amber, and other electrical Bodies, attract the Smoke ariſing from an extinguiſhed Candle: and where the Smoke riſes thick and groſs, the Amber attracts it ſtrongly; but weaker, as the Smoke aſcends higher, and becomes rarer.

29. The Matters attracted by electrical Bodies, receive no manifeſt Alteration but in their Tendency[g]. See the *Articles* ATTRACTION, MAGNETISM, and SYMPATHY.

[f] What is *Sarca*? Was not *Sarcocolla* the thing intended?

[g] It is obſervable, that many of the Experiments above ſet down, are capital or leading Experiments; whence it appears ſtrange, that the Enquiry has not been farther proſecuted, or driven to ſome ſolid Concluſion before this time. See Mr. *Boyle*, Dr. *Hook*, Mr. *Hauksbee*, Mr. *Steven Gray*, &c. in the *Philoſophical Tranſactions*, &c.

EXERCISE.

Exercise of the Body. Much Motion and Exercise is good for some Bodies; but Sitting, and less Motion, for others. If the Body be hot, and free from superfluous Moisture, too much Motion is hurtful: and 'tis an Error in Physicians, to call out so much upon Exercise [h]. Men should likewise beware how they use Exercise, and a spare Diet, at the same time: but if much Exercise, then a plentiful Diet; and if a spare Diet, then little Exercise is best. The *Its Advantages.* *Advantages* of Exercise are, (1.) that it sends Nourishment into the Parts more forcibly; (2.) that it helps to expel by Sweat, and so makes the Parts assimilate more perfectly; (3.) that it renders the Substance of the Body more solid and compact; and therefore less apt to be consumed, and preyed *And Disadvantages.* upon by the Spirits. The *Disadvantages* of it are, (1.) that it makes the Spirits more hot and predatory; (2.) that it absorbs, and over attenuates the Moisture of the Body; (3.) that it makes too great a Concussion of the internal Parts, especially if it be violent; whilst these Parts rather delight in Rest. But, in general, much Exercise is an Enemy to long Life; which is one Reason why Women live longer than Men; *viz.* becaufe they use less Action [i].

F.

FAT.

That Flesh is convertible to Fat. NEarly all Flesh may be turned into a fatty Substance, by cutting it to Pieces, and putting it into a Glass, covered with Parchment; then letting the Glass stand six or seven Hours in boiling Water. This may be a profitable Experiment for making Fat, or Grease: but then it must be practised upon such Flesh as is not edible; *viz.* that of Horses, Dogs, Bears, Foxes, Badgers, *&c.* [k]

FEVERS.

The Effect of southern Winds upon Health. 'Tis noted by the Ancients, that the Southern Winds blowing much, without Rain, cause a feverish Disposition of the Year; but not, if Rain attend them: for tho the Southern Winds may dispose the Air to breed Fevers; yet, when Showers are joined, these refrigerate in part, and

[h] *Viz.* Without considering the precise Cases, where it is proper, and where improper.

[i] Does not this short Aphorism contain the Foundation of the whole Enquiry into the Advantages and Disadvantages of Exercise to the Body? And yet, in what Light does the Doctrine of Physicians appear upon the Subject? *Alii aiunt, alii negant:* and the Patient is left without a Rule.

[k] Has this Experiment been verified? Or can *Flesh*, cleared of all its Membranes, and fine unctuous Skins that lie betwixt the Muscles of Animals, be converted into Fat, by so easy an Operation as that of the *Balneum Mariæ*? And how far is the same, or a similar Method, practicable upon both vegetable and animal Substances; by means of the DIGESTOR? And would not the same Instrument turn many vegetable Substances into Oil, more readily than long continued Coction? The *Digestor* seems fitted to disclose many Secrets in Nature; tho, at present, it appears to lie neglected.

and check the ſultry Heat of the Southern Wind. And hence the Obſervation holds not on the Sea-coaſts; becauſe the Vapour of the Sea refreſhes, without the Aſſiſtance of Showers [l].

FEWEL.

1. *'Tis reported*, that at the Foot of a Hill near the *Dead Sea*, there is a black Stone, whereof the Pilgrims make Fires, which burns like a Coal, without diminiſhing; only grows brighter and whiter [m]. That this ſhould be true, is countenanced by *Iron*; which, when red hot, burns without conſuming [n]: but the Strangeneſs is, that this Fewel ſhould continue any time; for Iron, when taken out of the Fire, grows preſently dead [o]. It were a thing of great Uſe and Profit, to find a Fewel that would burn ſtrong, and durably. And, perhaps, there may be ſuch Candles as *they ſay* are made of Salamander's Wool; being a kind of *Mineral*, which whitens alſo in the burning, and conſumes not [p]. Flame muſt be made of ſomewhat, and is commonly made of a tangible Body, which hath weight; but 'tis not impoſſible it ſhould be made of *Spirit*, or *light Vapour*, in a Body; ſuch as the Matter of an *Ignis Fatuus* [q]: but then the Vapour can only laſt a ſhort time; tho, by the help of Oil, Wax, and other Candle-ſtuff, the Flame might be continued, and the Wieck not burn [r]. *A Fewel that conſumes little.*

2. *Seacoal* laſts longer than *Charcoal*; and *Charcoal* made of Roots, being coaled in large Pieces, laſts longer than ordinary. Turf, Peat, and Cow-ſheards, are cheap Fewel, and laſt long [s]. Small-coal, or Briar-coal, put among Charcoal, makes it laſt longer. *Sedge* is a cheap Fewel to brew or to bake with; and 'tis good for little elſe. Trial ſhould be made of ſome Mixture of Seacoal and Earth [t]: if ſuch Artifice be practiſed clandeſtinely, as the Seacoal-men uſe it, to increaſe the Bulk of the *Attempts for making a cheap Fewel.*

[l] A competent Set of cloſe Obſervations ſeems ſtill required, to let us fully into the *Cauſe of Fewers*: how *mechanically* ſoever the Moderns may have *accounted* for them.

[m] Is the Fact certain?

[n] Does red hot Iron burn without conſuming?

[o] May not two or three red hot Bars of Iron, laid a-croſs, like Sticks, on a Fire, be blown by Bellows into a manifeſt Flame?

[p] Is not this a Preparation of the Asbeſtos?

[q] The Nature of the *Ignis Fatuus*, remains to be enquired into: at preſent, it ſeems chiefly uſed as a *Term*, and a *help to Diſcourſe*.

[r] See Mr. *Boyle* upon the Subject of *Phoſphori*.

[s] Are there not immenſe Quantities of a black ſtringy Earth, or *Peat*, to be found fit for Fewel, in moſt Counties of *England*? Is not this Earth an extremely proper Fewel for Iron? May not great Quantities of Iron-Stone, or Iron-Ore, be found adjacent to ſuch *Peat*? And is not this *Peat* eaſily changed into a better Coal, for moſt Purpoſes, than the common *Pit* or *Seacoal*; and ſuperior, in many Reſpects, to the *Turf* of *Holland*?

[t] Trial, is ſaid, to have been made to advantage; by uſing what they call *Sleak*, or common *Seacoal* accidentally broke, or purpoſely ground ſmall, and formed with fat River Mud, into Cakes, or Balls, of a proper Size for the Fire: by which Means they obtain a cheap, durable Fewel, tho ſomewhat offenſive by its Smoke and Smell; almoſt like that of the *Dutch Turf*, or preſſed Wine-Lees; which likewiſe make a ſulphureous kind of Fewel, that burns bluiſh, with a diſagreeable Odour. See ſomewhat to this general Purpoſe, in Mr. *Boyle's Eſſays upon the Uſefulneſs of Philoſophy*.

the Coal, 'tis deceit; but if uſed honeſtly, and publickly, 'tis good Huſbandry [t]. See the *Article* FLAME.

FIRE-WORKS.

The Nature of Bitumen.

Some imagine, that *Wild-fires*, principally compoſed of *Bitumen*, cannot be quenched with Water, becauſe the original Concretion of *Bitumen* is a Mixture of a fiery and watery Subſtance; which *Sulphur* is not. And at the Place, near *Puteoli*, which they call *Vulcan*'s *Court*, is heard, under the Earth, a horrible Thunder of Fire and Water conflicting together: and in the ſame Place break out Spouts of boiling Water. Now this Place yields great Quantities of *Bitumen*; whereas *Ætna*, *Veſuvius*, and the like fiery Mountains, which conſiſt of Sulphur, dart out Smoke, and Aſhes, and Pumice; but no Water. 'Tis alſo reported, that *Bitumen* mixed with Lime, and put under Water, will make a kind of artificial Rock; the Subſtance grows ſo hard [u]. See the *Article* GRAVITY.

FISH.

Sea Fiſh *recommended for* freſh Waters.

It appears that Fiſh, accuſtomed to ſalt Water, rather delight in freſh. So *Salmons* and *Smelts* affect to get into Rivers, tho it be againſt the Stream. At the Haven of *Conſtantinople* are great Quantities of Fiſh from the *Euxine* Sea, that, coming into the freſh Water, grow intoxicated, and turn up their Bellies; ſo as to be taken with the Hand. There ſeems not to have been ſufficient Experiments made of putting *Sea Fiſh* into *freſh Water-Ponds*, and Pools [v]. 'Tis a thing of great Uſe and Pleaſure; for thus one might have them new, at a diſtance from the Sea: and, perhaps, the Fiſh will eat the pleaſanter, and may breed. It is ſaid, that *Colcheſter Oyſters*, which are put into Pits, where the Sea goes and comes, yet, not ſo as to exclude freſh Water, when the Sea empties, grow by this means fatter, and fuller [w].

FIXATION.

Fixation of Bodies.

Gold is the only Subſtance, that has no *volatile Parts*, yet melts with eaſe [x]. The melting ſhews it not jejune, or wanting in *Spirit* [y]; ſo that its fixing,

[t] The *Buſineſs of Fewels* is far from being advanced to Perfection. Let an Enquiry be made into the Ways of uſing *Caſt Iron* for *Fewel*. It ſeems to have been little obſerved, that *Iron* is a *Fewel*; or capable of yielding a great degree of Heat, in proportion to the Fire that acts upon it. See Dr. *George Erneſt Stahl*'s *three hundred chemical Experiments and Obſervations*, printed at *Berlin*, 1731.

[u] The *Natural Hiſtory of Bitumen*, or *Aſphaltum*, ſeems to lie in obſcurity; and its *philoſophical*, or *chemical Hiſtory*, is ſcarce touched upon. Firſt, therefore, let the *Subſtance* be well defined and deſcribed; then chemically treated, analyſed, and compared with *Naphtha*, *Petreol*, *Camphire*, *Sulphur*, *Pitch*, *Roſin*, *pitchy Coals*, and the *Caput Mortuum* of *Amber*, &c. See *Boerhaave*'s *Chemiſtry*.

[v] Some few Trials of this kind ſeem to have been made of late. See Mr. *Chambers*'s *Univerſal Dictionary*, under the *Article*, FISHERY, *&c.*

[w] There are ſome Papers upon this Subject in the *Philoſophical Tranſactions*, and the *French Memoirs*; but, perhaps, it has not been cultivated as it deſerves.

[x] That is, Gold is a very fixed Body in the common Fires: but is it not extremely volatile in the Focus of a Burning-concave?

[y] See the *Note* upon the *Article* COLOURS.

fixing is not from a Poverty of *Spirit* to fly out; but the equal ſpreading, and cloſe Coacervation of its tangible Parts: whereby the Spirits have the leſs Appetite, and Opportunity of eſcaping [a]. It were, therefore, proper to try whether Glaſs in melting loſes weight [b]: for the Parts of Glaſs are evenly ſpread; but not ſo cloſe as in Gold. This appears from its eaſy Admiſſion of Light, Heat, Cold; and its want of Gravity. Other fix'd Bodies have little or no *Spirit*; ſo that there is nothing to fly out: as in the Bone-Aſhes, whereof Cupels are made; which ſtand the Fire without Loſs [c]. So that there are three *Cauſes of Fixation*; viz. (1.) the even Diffuſion of the Spirits, with the tangible Parts; (2.) the Cloſeneſs of the tangible Parts; and (3.) the Jejuneneſs, or extreme Comminution of the Spirits. The two firſt may be joined with a *liquifiable Nature*; the laſt not [d]. See the *Articles* GOLD, GRAVITY, TRANSMUTATION, *&c.*

FLAME.

1. *Flame* and *Air* do not mix, except it be in an Inſtant, or in the *vital Spirits of Vegetables, and Animals* [e]. The force of *Gunpowder* hath been aſcribed to a Rarefaction of the earthy Subſtance into Flame. To examine the matter cloſely; Nitre contains an extraordinary, crude, and windy *Spirit*; which firſt, by the heat of the Fire, ſuddenly dilates itſelf; and thus dilated, blowes abroad the Flame, like internal Bellows. Whence Brimſtone, Pitch, Camphire, Wild-fire, and many other inflammable matters, tho they burn violently, and are hard to quench; yet make no ſuch *fiery Wind*, as Gun-powder does. On the other hand, Quickſilver heated, and pent in, hath the like force with Gun-powder [f]. The *vital Spirits of Animals are a Subſtance compounded of an airy and flamy Matter*; and tho *Air* and *Flame*, will not well mix, when free; yet they may when bound in by a *fixing Body*. So their *Aliments*, *Water* and *Oil*, do not well mix of themſelves; but in the Bodies of Plants, and living Creatures, they do [g]. *The Commixture of Flame and Air.*

No

[a] May not ſome of the Matter which flies off from Gold, expoſed to the action of a *Burning-Glaſs*, be called its Spirits, or mercurial Part; and the remaining purple Glaſs its jejune, ſpiritleſs, or fixed Part?

[b] By long continued melting, Glaſs is found to loſe in weight; and at the ſame time to increaſe proportionably in hardneſs.

[c] Does the Matter of the Cupel ſuſtain no diminution in Cupellation?

[d] Dr. *Stahl*, in his *Chemical Pieces*, has given more light to this Affair, from direct *Experiment* and *Obſervation*, than would be eaſily credited. And till his Diſcoveries are underſtood, and even carried much farther; we ſhall not fully perceive the depth of the Lord *Bacon*'s Sagacity, in driving at the *Cauſes of natural Things*.

[e] This Subject requires an attentive Examination. The Author is intent upon it in other parts of his Works; as, particularly, in his *Hiſtory of Life and Death*. It contains perhaps one of the greateſt Myſteries in all *Phyſicks*; and a Secret poſſibly the next to that of the Union betwixt Soul and Body. But let the exacteſt Care be had in the Enquiry, to go no farther than Experience, Obſervation, cloſe Reaſoning, and, in one word, *preciſe Induction* carries us.

[f] Is not the Force of Quickſilver confined, and endeavouring to get looſe, in a ſtrong Digeſtor, expoſed to a violent Heat, greater than that of fired Gunpowder, weight for weight?

[g] Great part of the Myſtery lies here. But is it certain, that Water is the Food of Air, or that *Water* is convertible into *Air*; as *Oil* is into *Flame*? The Author brings Inſtances to prove

No wonder therefore, that a ſmall quantity of Spirits, in the Cells of the Brain, and Canals of the Nerves, are able to move the whole Body, with ſo great Force as we ſee in Wreſtling, or Leaping; and with ſo great Swiftneſs, as in running Diviſions upon the Lute: ſuch is the force of Air and Flame when they incorporate [h].

The ſecret Nature of Flame,

2. A ſmall wax Candle, being ſet in a Socket, and placed upright in a Porringer of heated Spirit of Wine; if both the Candle, and the Spirit of Wine be lighted, the Flame of the Candle will open itſelf, and become four or five times bigger, than otherwiſe it wou'd have been; and appear Globular, not Pyramidal: Whilſt the inward Flame of the Candle keeps its Colour; without turning Blue, like the Flame of Spirit of Wine.

Farther open'd by an Experiment.

3. This noble Experiment ſhews two remarkable Things: The *one*, that two Flames quench not each other; but remain perfect, permanent Bodies; as Air, or Water. And therefore Flame wou'd ſtill aſcend upwards in the ſame Magnitude, if not quenched on the ſides; and the greater the Flame is at the bottom, the higher it riſes [i]. The *other* Thing is, that Flame doth not mix with Flame, as Air with Air, or Water with Water; but only remains Contiguous; as in conſiſtent Bodies. Hence alſo the pyramidal Form of Flame is merely accidental; as the ſurrounding Air, by quenching the ſides of the Flame, ſqueezes it into that Form; for of itſelf it wou'd be round: and, therefore, Smoak riſes in the Figure of an *inverted Pyramid*; for the Air quenches Flame, but receives Smoak. Note, alſo, that the Flame of a Candle, within the Flame of the Spirit of Wine, is diſturbed; and doth not only open and move upwards, but wave to and fro: as if Flame, of its own Nature, were it not quenched, wou'd roll and turn, as well as move upwards. By all which it ſhou'd ſeem, that the *fixed Stars are true Fires* or *Flames*, as the *Stoicks* held; finer perhaps, and more rarified; than our Flame is. For, (1.) they are Globular and Determinate; (2.) they have Rotation; and (3.) they have the Colour and Splendor of Flame: ſo that *Flame* above ſeems durable, conſiſtent, and in its natural place; but with us a Stranger, momentary, and impure; like *Vulcan* halting with his Fall [k].

4. Hold

prove it in his *Hiſtory of Winds*; but the Doctrine is not, perhaps, ſo firmly and clearly eſtabliſhed, as it requires. The Experiments of Mr. *Boyle* are rather conſtrued againſt; but has not Sir *Iſaac Newton* given conſiderable Light to this Matter, in his Queries?

[h] Conſult Mr. *Boyle*, and farther Experience upon the Subject.

[i] Obſerve the Method of arguing from Experiments by Induction; according to the Laws of the *Novum Organum*: but remember, that all is ſubmitted to *Verification*, and the *Proof of Axioms*.

[k] Here we have an Inſtance of the capital Uſe of Leading Experiments; the Advantage of the *Rules of Philoſophizing*, lately laid down by Sir *Iſaac Newton*; and the ſurprizing Lengths whereto obvious Experiments may reach, in diſcloſing the Works of Nature. In ſhort, almoſt every new *Experiment* that is made, may be a means of opening a new Scene in Nature; eſpecially when exactly verified, and extended by *Induction*; or according to Sir *Iſaac Newton's Regulæ Philoſophandi*. See more to this purpoſe in Dr. *Pemberton's Introduction to his View of Sir* Iſaac Newton's *Philoſophy*.

4. Hold an Arrow in Flame, for ten Seconds; and the Parts on the outside will appear more burnt, black, and turned almoſt to a Coal, whilſt thoſe in the middle will appear as if the Fire had ſcarce touched them. This is an *Inſtance* of Conſequence, for diſcovering the nature of Flame; and ſhews that Flame burns more violently towards the ſides, than in the middle [l]; and that Heat, or Fire, is not violent or furious, but where checked and reſtrain'd. Whence the *Peripateticks* ſeem properly to anſwer the Objection, that if a Sphere of Fire encompaſs the Earth, all Things would be burnt up; by alledging, that pure *elementary Fire*, in its own place, and not irritated, has but a moderate Heat [m]. *The different force of Flame; in the midſt, and on the ſides.*

5. The Continuance of *Flame*, according to the difference of the Body inflamed, and other Circumſtances, is worthy the Enquiry; chiefly becauſe *Flame* tho almoſt momentary, yet receives degrees of more, and leſs. A Spoonful of *Spirit of Wine*, a little heated, burnt for a hundred and ſixteen Seconds. The ſame quantity, mixed with the ſixth part of a Spoonful of Nitre, burnt but ninety-four Seconds. Mix'd with the like quantity of Bay-Salt, eighty three Seconds. Mix'd with the like quantity of Gun-powder, which diſſolved into a black Water [n], a hundred and ten Seconds. A Cube of yellow *Wax*, equal to half the *Spirit of Wine*, ſet in the midſt, burnt only the ſpace of eighty-ſeven Seconds. Mix'd with the ſixth part of a Spoonful of Milk, it burnt a hundred Seconds; and the Milk was curdled. Mix'd with the ſixth part of a Spoonful of Water, it burnt eighty-ſix Seconds; and with an equal quantity of Water, only four Seconds. A ſmall Pebble was laid in the midſt, and the Spirit of Wine burnt ninety-four Seconds. A piece of Wood, the bigneſs of an Arrow, and about a Finger's length, being ſet up in the midſt, the *Spirit of Wine* burnt ninety-four Seconds. So that the *Spirit of Wine* ſimple, endured the longeſt; and the Spirit of Wine with Bay-Salt, and the equal quantity of Water, the ſhorteſt time. *The Continuance of Flame.* *In Spirit of Wine.*

6. Note, that in the *Experiment of Wax*, the Wax diſſolved in the burning, tho without incorporating with the *Spirit of Wine*, ſo as to produce one Flame; but where the Wax floated, the Flame forſook it; till at laſt it ſpread all over, and put the Flame quite out. Conſider, whether the more ſpeedy extinction of the Flame be cauſed by its great Vigour in burning; or by the Reſiſtance of the additional Body, and the Averſion thereof to take Flame: which will appear by the quantity of the *Spirit of Wine*, that remains after the Flame goes out. It ſeems to be the latter; be- *Obſervations relating to the preceding Experiments.*

[l] This Obſervation is proſecuted by Dr. *Hook*, in order to ſhew the Nature of *Fire* and *Flame*.

[m] It were proper to collect the ſeveral Inſtances that ſhew the weak effects of Flame, in the internal, and its Strength on the external Parts; as in firing of Brandy on the Finger; the burning of inflammable Spirits on Linen, without ſingeing; the burning of Oil without touching the *Wieck*, &c. See Mr. *Boyle*, Dr. *Hook*, Dr. *Stahl*, &c. and M. *Homberg* on *Phoſphorus*, &c. See alſo the *Chapter of Fire*, in *Boerhaave's Chemiſtry*.

[n] Hence it is evident, that the Spirit of Wine was not high rectified; and therefore theſe *Experiments* can by no means be depended upon, for Preciſion or Exactneſs; but ſhou'd be repeated with *perfectly dephlegm'd Spirit*.

cauſe the Mixture of the Things leaſt apt to burn, goes out the ſooneſt. And Note, by the way, that *Spirit of Wine* burnt, till it goes out of itſelf, will burn no more; and taſtes not ſo hot in the Mouth as it did; nor yet ſour, as burnt Wine does; but flat and dead [o].

Experiments relating to the duration of Candles, differently prepared.

7. Pure Wax, made into a Candle, and Wax mix'd into Candle-ſtuff, (1.) with Water, (2.) Spirit, (3.) Milk, (4.) Bay-Salt, (5.) Oil, (6.) Butter, (7.) Nitre, (8.) Brimſtone, and (9.) Saw-duſt, ſeverally; in the proportion of a ſixth part to the Wax; and made into Candles of the ſame Weight and Wieck with that of Wax, burnt thus. That with *Saw-duſt* conſumed the faſteſt; but burnt fair till ſome part of the Candle was waſted; and the Duſt gathered about the Snuff, which then grew big, long, and burnt dimly; and the Candle waſted in half the time of the pure Wax. The *Candles with Oil and Butter* conſumed a fifth part ſooner than the pure Wax. Next, burnt out the *Candle of pure Wax itſelf:* Then that with *Bay-Salt*; which laſted about an eighth longer than the Wax. Next followed that *with Spirit*; which laſted about a fifth part longer than the Wax. Then followed thoſe with *Milk* and *Water*, with little difference; only that with Water conſumed the ſloweſt. And in theſe four laſt, the Wieck ſpit forth little Sparks. That with *Nitre* would not keep lighted above twelve Seconds; and all the while ſpit out portions of Flame; which afterwards turn'd to Vapour. The Candle with *Brimſtone* kept lighted much like to that with *Nitre*; but, in a ſhort time, it hardned, and caked about the Snuff: ſo that the *mixture of Bay-Salt with Wax*, gains an eighth part; and that with *Water* a fifth, in point of Duration [p].

Experiments for rendring Lights durable, by ordering the Wieck.

8. Trial was made with different *Wiecks*; *viz.* (1.) of ordinary Cotton, (2.) Sewing Thread, (3.) Ruſh, (4.) Silk, (5.) Straw, and (6.) Wood. The *Silk*, *Straw*, and *Wood* flamed a little, till they came to the Wax, and then went out; the *Thread* conſumed faſter than the *Cotton* by a ſixth Part; next conſumed the *Cotton*; and the *Ruſh* conſumed ſlower than the Cotton, by at leaſt a Third. The Cotton and Thread gave a Flame much alike; but the Ruſh much leſs, and dimmer [q].

(2.) *By hardning the unctuous Matter.*

9. Good Houſe-wives, to make their Candles burn the longer, lay them, one by one, in Bran, or Flower; which rendring them harder, they thus conſume the ſlower: inſomuch as to burn twice as long as Candles of the ſame ſort, not ſo treated. For Bran and Flower have a power to harden; ſo that both Age, and lying in the Bran, conduces to their laſting. And Wax Candles

[o] It is ſufficiently known that *high rectified Spirit of Wine* burns dry, without leaving the leaſt Moiſture behind; and that this Spirit is a thing immenſely different from Wine. The *Eſſay* I publiſhed upon *inflammable Spirits*, may give ſome farther Light in this matter.

[p] To determine the beſt and cheapeſt Materials for Candle-ſtuff, may require ſome Attention, and a variety of Experiments. *Wax* is an excellent ſubſtance for the purpoſe; were it but near ſo cheap with us as in the *Eaſt-Indies*: whence it might deſerve a particular Enquiry, how to render it cheaper in *Europe*; and with what Subſtitutes, we are in this Caſe provided. See the *Articles* FAT, FEWEL, and FIRE-WORKS.

[q] It is no bad Expedient, which the poor People have in ſome Parts of *England*, to dip Ruſhes in their melted Kitchen-ſtuff, or common Train-Oil, and burn them about the Houſe, inſtead of Candles. The *Wax-cloth*, which comes by way of Wrapper, from the *Eaſt-Indies*, is much neater; and makes an agreeable Taper.

dles burn longer than Tallow ones; becauſe Wax is more firm and hard than Tallow [r].

10. The *Duration of Flame* alſo depends upon the eaſy ſupply of the Nouriſhment: Thus, in the *Court of* England, there is a *Service*, they call *All-Night* [s]; being a kind of a great Cake of Wax, with a Wieck in the middle; which thus derives its ſupply at a diſtance [t]. So Lamps alſo laſt the longer; becauſe their Veſſel is much broader than a Taper or Candle. (3.) *By due ſupply to the Flame.*

11. Take a Turret-Lamp of Tin, made ſquare; the height of the Turret being thrice that of the lower part, whereon the Lamp ſtands: make only one Hole in it, at the end of the Return fartheſt from the Turret: reverſe it, and fill it full of Oil by that Hole; then ſet it upright; put a Wieck in at the Hole; light it: and it will burn ſlow and long; becauſe here alſo the Flame derives its Nouriſhment afar off [u]. And as the Oil waſtes and deſcends, ſo the top of the Turret gradually fills with Air; from the Rarefaction of the Oil by Heat. It were proper to make a Hole in the top of the Turret, and try when the Oil is almoſt conſumed, whether the Air generated by the Oil will enflame, if a Candle be applied to it, in letting of it out [v]. It were proper alſo to have the Lamp made, not of Tin, but of Glaſs; to ſhew how the Vapour, or Air, gathers by degrees in the top [w]. *The Structure of a Lamp, for a laſting Light.*

12. Another thing conducing to the duration of the Flame, is the Cloſeneſs of the Air, wherein the Flame burns. The Wind blowing upon the Candle waſtes it apace. Hence a Candle laſts longer in a Lanthorn than at Large. And *there are Traditions* of Lamps and Candles, that have burnt a very long time in Caves and Tombs [x]. (4.) *By ſkreening the Flame.*

13. The laſt particular, to the ſame purpoſe, is the *Nature of the Air*, wherein the Flame burns; whether it be hot or cold, moiſt or dry. The Air, if very cold, irritates the Flame, and makes it burn more fiercely; and ſo forwards the Conſumption. The Air once heated, makes the Flame (5.) *By regulating the Air.*

[r] If Hardneſs be a principal Reaſon why Wax burns more durably than Tallow; cou'd not a way be found, to render Tallow nearly as hard as Wax?

[s] I ſuppoſe from its burning all Night, without any freſh Supply.

[t] For the Conſtruction of Lamps, ſee Dr. *Hook*'s LAMPAS; and Mr. *Boyle*'s Contrivance of a *Lamp*, in the *Philoſophical Tranſactions*.

[u] How is the ſupply of a Lamp render'd eaſier, by deriving its Fewel from a conſiderable diſtance? Or what is the beſt Diſtance to be obſerved betwixt the Fewel and the Flame?

[v] There is a curious Diſcovery intimated in this Direction, which few ſeem to have attended to; except Dr. *Stahl*. See his *Experimenta, Obſervationes, & Animadverſiones, 300 numero*.

[w] There are ſome very late Applications of Glaſs Veſſels for Lamps. Conſider the nature of the *Convex Lamp*: and try to improve the common Structure. See Dr. *Hook*'s *Lampas*.

[x] What degree of Truth is found in theſe Relations? or what the preciſe Matter of Fact? See the Writers upon Antiquities; and the Chemical Philoſophers, upon the Subject of *Phoſphori*, particularly Mr. *Boyle*.

burn milder; and ſo promotes its Continuance. The Air, if dry, is indifferent; and, if moiſt, it quenches the Flame, in ſome degree, (for Lights go out in the Damps of Mines,) or makes it burn more dully, and ſo prolongs its duration [y].

The riſe of Water by means of Flame.

14. Set a lighted Candle at the bottom of a Baſon of Water, and turn the mouth of a Glaſs over the Candle; and the Water will riſe into the Glaſs. For the Flame of the Candle, when cover'd, being ſuffocated by the cloſe Air, leſſens by degrees; during which time there is ſome little gradual aſcent of Water. But upon the Inſtant the Candle goes out, there is a ſudden riſe of a great deal of Water; the body of the Flame now filling no more ſpace, ſo that the Air and the Water ſucceed [z]. The effect is the ſame, if, inſtead of Water, Flower or Sand be put into the Baſon [a].

FLESH.

Of eatable and uneatable Fleſh; in Beaſts.

1. Of Fleſh, ſome is edible, and ſome not; except in Famine; as having commonly too much bitterneſs of Taſte: and therefore cholerick Creatures, are not eatable; ſuch as *Lions*, *Wolves*, *Squirrels*, *Dogs*, *Foxes*, *Horſes*, &c. [b] But *Kine*, *Sheep*, *Goats*, *Deer*, *Swine*, *Rabbits*, *Hares*, &c. are mild and fearful Creatures. Yet *Horſes*, which are Beaſts of Courage, we find are eat by ſome Nations: whence the *Scythians* were call'd HORSE-EATERS; and the *Chineſe* eat Horſe-fleſh at this Day; and ſome Epicures have eat Colt's-fleſh baked.

Birds.

2. Among *Birds*, the Carnivorous, and *Birds of Prey*, are commonly not good to eat. The reaſon is rather the cholerick Nature of ſuch Birds [b]; than their feeding upon Fleſh; for *Pewets*, *Gulls*, *Ducks*, &c. which feed upon Fleſh, are good Meat, when very young. And thoſe Birds of Prey that feed upon Fleſh, as Hawks, Rooks, Owls, *&c.* are tolerable Food.

And Men.

3. Man's Fleſh is not eaten; (1.) becauſe Men, in Humanity, abhor it [c]: (2.) Becauſe no living Creature that dies of itſelf, is good to eat: whence the *Canibals* eat only the Fleſh of the ſlain. And (3.) becauſe there muſt generally be ſome Diſparity between the Nouriſhment, and the Body nouriſhed [c]: yet we ſee, in great Weakneſſes and Conſumptions, Men have been ſuſtained with Woman's Milk. *'Tis ſaid*, that Witches greedily devour Man's Fleſh [d]; which, *if true*, may proceed, from hence, that human

[y] This Subject requires a farther Experimental Enquiry into the Nature of Fire and Flame. The three hundred *Experiments* and *Obſervations* of Dr. *Stahl*, mentioned above, have a particular Tendency this way.

[z] May not ſome very conſiderable Diſcoveries be derived from this Experiment? And does not the late noble *Fire-Engine*, for raiſing Water, depend upon this Power?

[a] Which may in ſome meaſure ſhew, that ſuch powdry Bodies approach to the Nature of Fluids.

[b] Have theſe Creatures a greater quantity of Bile, in proportion, mixed with their Blood, than others?

[c] This is farther explained in the *Author's Hiſtory of Life and Death.*

[d] What Truth is there in that Report of the fine Taſte of human Fleſh; for which it is ſaid to be coveted by ſome *Americans?* And by what means was the eating of Man's Fleſh introduced in that Country; whilſt it is ſo deteſted by other Nations? Was this thro' *Choice*, or *Neceſſity?*

human Fleſh ſends up high and pleaſing Vapours, which ſtir the Imagination; for the *Felicity of Witches is chiefly in Imagination.* See the *Articles* FOODS and POISONS.

FLYING.

Of flying in the Air.

'Tis anciently reported of the *Leucadians*, that out of Superſtition, they uſed to precipitate a Man from a high Cliff into the Sea; firſt tying about him many large Fowls; and fixing to his Body various Feathers, expanded, to break the Fall. And doubtleſs Birds of a good Wing, might fly loaded with a conſiderable Weight: and Feathers ſpread broad and cloſe, will likewiſe buoy up a great Weight. The farther Application of this Experiment for flying, may be thought upon [e]. See the *Article* GRAVITY.

FOODS.

The Cauſes of Appetite and Satiety, viz.

1. Some *Foods* may be uſed long, and in quantity, without cloying; as Bread, lean Fleſh, *&c.* others, tho pleaſant, glut ſooner; as Sweet meats, fat Things, *&c.* The *Cauſe* is, that Appetite conſiſts in emptineſs of the Stomach; or its upper Orifice being poſſeſſed with ſomewhat that is aſtringent, and therefore cold and dry. But Things ſweet and fat are more filling, and float and hang more about the Mouth of the Stomach; and go not down ſo ſpeedily: and again turn ſooner to Bile; which is hot, and always allays the Appetite [f].

2. Another *Cauſe of Satiety*, is too great Cuſtom; and the Appetite of Novelty: whence the ſame Meats continually taken, induce loathing. To aſſign the reaſon for the Diſguſt of Satiety; and of the Pleaſure of Novelty; and to diſtinguiſh, not only in Meats and Drinks, but alſo in Motions, Love, Company, Delights, Studies, which they are that Cuſtom makes more grateful, and which more irkſome, were a large Field. But for Meats, the *Cauſe is Attraction*; which is quicker, and keener towards new Things, than towards ſuch as have left a Reliſh by former Uſe. And generally 'tis a Rule, that whatever is a little ungrateful at firſt, is rendred grateful by Cuſtom; but whatever is too pleaſing at firſt, quickly turns to Satiety.

What Meats afford moſt Nouriſhment.

3. *Vegetables* have ſome Parts more nouriſhing than others: thus *Grain* and *Roots* nouriſh more than *Leaves*; inſomuch that the *Order* of the *Folietani* was put down by the *Pope*, upon finding *Leaves* unable to nouriſh the Body [g]. Whether there be that difference in the Fleſh of living Creatures, is not yet well known: as whether *Livers*, and other *Entrails*, be not more nouriſhing than the outward Fleſh. We find that amongſt the *Romans* a Gooſe's Liver was a great Delicacy; whence they had artificial Means

[e] See Biſhop *Wilkins's Dædalus*; and conſider the Expedients of *Friar Bacon*, and ſome later mechanical Writers for this purpoſe.

[f] Is there not ſomewhat deeper in this Affair, depending chiefly upon the Juices, or what may properly be called the *Menſtruums* of the Stomach? See the *Article* CONCOCTION.

[g] What were the particular Rules to which this *Order* obliged themſelves? Were they reſtrained to feed on the Leaves of Trees only? For there ſeems to be conſiderable Nouriſhment in boiled Lettice, Cabbage, and other Plants of a large and tender Leaf.

Means to make it fair and large; but whether it were more nouriſhing, does not appear [g]. It ſeems certain, that *Marrow* is more nouriſhing than Fat. And, I conceive, that a Decoction of Bones and Sinews, ſtamped, and well ſtrained, wou'd make a very nouriſhing Broth [h]. We find alſo that *Scotch Skinck*, a Pottage of ſtrong Nouriſhment, is made with the ſkins and ſinews of Beef, long boil'd. *Jelly* likewiſe, is chiefly made of knuckles of Veal. The Pulp within the Craw-fiſh, or Crab, is more nouriſhing than the Fleſh. The Yolks of Eggs are more nouriſhing than the Whites. Whence it ſhou'd ſeem that the Parts of living Creatures which lie more inward, may nouriſh better than the outward Fleſh [i]. And for the nouriſhing of aged Men, or Perſons in Conſumptions, ſome ſuch Thing might be deviſed, as ſhould be half *Chyle*, before it comes into the Stomach [k].

An Experiment for making a nutritive Drink.

4. For Example; Parboil two large Capons, upon a ſoft Fire, for an Hour, till the Blood diſappear in that form. Add, in the Decoction, the peel of a ſweet Lemmon, or Citron, and a little Mace. Throw away the Shanks, and mince the two Capons, Bones and all; and put them into a large Boulter. Then take a ſweet, and well-ſeaſon'd Kilderkin, containing four Gallons of eight Shilling Beer, new as it comes from the Tun; make a large Bung-hole in the Kilderkin, at which thruſt in the Boulter, with the Capons: let it ſteep, and work three Days and Nights, with the Bung-hole open; then cloſe the Veſſel: and ſo let it continue a day and a half. Now draw it into Bottles; and drink it after three Days ſtanding. It will keep ſix Weeks, drink freſh, and flower and mantle exceedingly; but taſte not newiſh at all. It is an excellent Drink for a Conſumption; to be uſed either alone, or mixed with other Beer. It quenches Thirſt; and has nothing of Windineſs. Note, it is impoſſible, that Meat and Bread, either in Broths, or taken with Drink, ſhou'd get into the Veins, and external Parts, ſo fine, and with ſo much eaſe, as when thus incorporated, and made almoſt *Chyle* beforehand [l].

Farther Trials recommended with Roots and Fleſh.

5. Trial of the like kind might alſo be made with Potatoes, *Bur-Roots*, and *Artichoak* Bottoms; which are nouriſhing Meats: and with other Fleſh; as *Pheaſant*, *Partridge*, *Pig*, *Veniſon*, but eſpecially that of Fawns, *&c.*

Capons and Almonds.

6. A Mortreſs or Soop, may be made of the Fleſh of Capons, ſtamped, ſtrain'd, and mix'd with an equal quantity of *Almond-Butter* [m]. This is an excellent Meſs, for nouriſhing thoſe that are weak; and better than Jellies.

So

[g] Has any conſiderable Light been given to this Affair, by the modern Enquirers?

[h] 'Tis found ſo by means of the DIGESTOR. See the *Author's* NEW ATLANTIS.

[i] No ſafe Induction can be made from a few *Inſtances*; eſpecially ſuch as are not *Capital*: Let the *Enquiry* therefore be farther continued.

[k] See the NEW ATLANTIS.

[l] The Author here ſpeaks from Experience: and certainly the Receipt is well calculated, and deſerves to be tried; eſpecially in Conſumptive Habits; or worn out Conſtitutions; and Perſons grown weak and feeble with Age.

[m] What the Author here means by *Almond-Butter*; is, perhaps, no more than a *rich Emulſion* of *blanched Almonds*, rather than a direct unctuous Subſtance.

So is the Cullis of Cocks, boil'd thick, with the like mixture of Almond-Butter: for the Cullis, or Soop, of itſelf, is more ſavoury and ſtrong, and not ſo fit to nouriſh weak Bodies; but the Almonds, that are not of ſo high a taſte as Fleſh, ſerve to qualify it.

7. *Indian Maiz* has an excellent Spirit of Nouriſhment; but it muſt be thorowly boil'd, and made into a *Maiz-Cream*, like *Barly-Cream*. I judge the ſame of *Rice*, made into a Cream; for Rice is a principal Food in *Turkey*, and other Eaſtern Countries: but it muſt be thorowly boiled, on account of its hardneſs; and becauſe, otherwiſe, it binds the Body too much. *Indian Maiz and Rice.*

8. *Piſtaches*, if good, and not muſty, join'd with Almond-Milk, or made into a Milk of themſelves, which is like Almond-Milk, tho greener; are an excellent Nouriſhment: but 'tis proper to add a little Ginger, becauſe they are not without ſome ſubtile Windineſs [n]. *Piſtaches.*

9. *Milk*, warm from the Cow, is found a great Nouriſher; and a good Remedy in Conſumptions: but as it is milking, there ſhould be put into it two little Bags; the one of *Powder of Mint*, the other of *Powder of Red-Roſes*; for theſe keep the Milk, in ſome degree, from turning, or curdling in the Stomach. Put in Sugar alſo, for the ſame Reaſon, and partly for the Taſte's ſake. But a large Draught ſhou'd be taken at once; that it may ſtay the leſs time in the Stomach, and ſo not curdle. And let the Cup into which it is milked, be ſet in a large Veſſel of hot Water; that it may be had warm. *Cow's Milk*, thus treated, I judge better for a Conſumption than *Aſſes Milk*; which indeed turns not ſo eaſily, but is a little harſh [o]. Cow's Milk is doubtleſs more proper for Sharpneſs of Urine, Exulcerations of the Bladder, and all Intentions where Lenifying is required. Womens Milk likewiſe is preſcribed, when all others fail; but I commend it not, as approaching a little too near the Juices of the Body, to be very nouriſhing; except in Children, to whom 'tis natural [p]. *Milk.*

10. *Oil of ſweet Almonds*, newly drawn, and mix'd with Sugar, a little Spice, and ſpread upon toaſted Bread, is an excellent Nouriſher; but then to keep the Oil from frying in the Stomach, a large draught of mild Beer ſhould be taken after it: and to prevent its relaxing the Stomach too much, uſe a little Cinnamon-Powder. *Oil of Almonds.*

11. The

[n] The Preparations of this kind ſeem in a manner neglected by Phyſicians and Apothecaries; and are turn'd over to the Women: tho as capable, perhaps, of proving ſerviceable in certain Diſtempers, as ſome Remedies now in uſe.

[o] What ſay the Phyſicians, and Men of Experience, to this? Their Practice runs the contrary way: but upon what foundation of Reaſon and Certainty? *Aſſes Milk* is ſaid to be thinner, and therefore imagined capable of paſſing the finer Veſſels, where thicker Milk would be excluded. But is this any other than a Conjecture? And cou'd not *Cows Milk* be properly diluted to an equal tenuity with *Aſſes* Milk? The Difference muſt be determin'd by a ſufficient number of competent Experiments; as well of the *Phyſical* and *Chemical*, as *Medicinal* kind.

[p] See this Subject farther proſecuted in the *Author's Hiſtory of Life and Death.*

Eggs. 11. The Yolks of Eggs are ſo well prepared by Nature for Nouriſhment, as to require nothing more than Poaching, or ſoft Boiling; tho they may be taken raw, when new laid, along with Malmſey, or ſweet Wine; whereto may properly be added, a few Slices of *Eryngo Root*, and a little Ambergreeſe: by which means, beſides the immediate Faculty of Nouriſhing, ſuch Drinks will be made corroborative; and not expel too faſt by Urine: for too plentiful a Diſcharge by Urine, hinders Nouriſhment.

The Mincing of Meat. 12. *Mincing of Meat* ſaves the Grinding of the Teeth; and therefore contributes to Nouriſhment, eſpecially in Age; or where the Teeth are weak: but Butter is not ſo proper for weak Bodies: it were therefore expedient to moiſten the minced Meat with Claret and Sugar, lightly aromatized with Cinnamon or Nutmeg.

The ſeveral Means of converting, or aſſimilating the Nouriſhment; viz. (1.) *Preventing its going off by* Urine, *and* Sweat. 13. There are ſeveral Means of *converting the Nouriſhment to its right* Uſe: the *firſt* is, *to procure that it be not diverted, or drawn away*; or, *to provide, that the Kidneys attract not an over-Proportion of the Blood into Urine.* To this add *Ariſtotle*'s Precept; that Wine be avoided in all *Conſumptions:* becauſe the *Spirit of Wine* preys upon the roſcid Juice of the Body, and robs the animal Spirits of their Nouriſhment. Therefore, if the *Conſumption* proceed from the Weakneſs of the Stomach, enforce the Uſe of Wine; but let it alway be *burnt*, that the more ſubtile Spirits may evaporate[1]. Add alſo, that too great Waſte of the Nouriſhment be prevented, by Exhalation and Sweat: ſo that, if the Patient be apt to ſweat, this muſt be gently reſtrained. But chiefly, *Hippocrates*'s Rule is to be followed; who adviſes quite contrary to what is in uſe: *viz.* that *the Cloathing next the Skin, be, in Winter, dry, and often changed; but, in Summer, ſeldom changed, and ſmeared over with Oil:* for certainly, any Subſtance that is fat, ſomewhat fills up the Pores of the Body, and prevents Sweat: but the more cleanly way is, to have the Linen ſmeared lightly over with Oil of ſweet Almonds; and to ſhift as often as is proper.

(2.) *By ſtrengthening the Stomach.* 14. The *ſecond* Means is, *to ſend the Nouriſhment more forcibly into the Parts, by ſtrengthening the Stomach*; and, as the Stomach is chiefly comforted by Wine, and hot things, which are otherwiſe prejudicial, 'tis proper to uſe *external Applications to the Stomach:* but it has been found, that the *Quilts of Roſes, Spices, Maſtich, Wormwood, Mint*, &c. are not ſo ſerviceable as *a Cake of new Bread*, ſprinkled with *Sack*, or *Alicant*; then dried a little before the Fire, wrapt in a clean Napkin, and laid to the Stomach: for all *Meal* has a great Power of Aſtriction; ſo as to harden Fleſh, or Flowers, laid in it: whence, alſo, a Bag, quilted with Bran, is very ſerviceable; tho it dries too much, and therefore ſhould not lie on too long.

(3.) *By indulging Sleep.* 15. The *third* Means is, *to diſtribute the Nouriſhment better by Sleep:* for Bears, and other Creatures that ſleep in Winter, grow exceeding fat: and, indeed, Sleep greatly nouriſhes the Spirits; not only becauſe the Nouriſhment is leſs ſpent in Sleep; but it alſo helps to propel the nutrimental Matter

[1] This may deſervedly appear an uſeful Caution.

ter into the Parts. Therefore, in aged Men, weak Bodies, and ſuch as abound not with Bile, a ſhort Sleep after dinner contributes to nouriſh: for in ſuch Bodies there is no fear of an over-haſty Digeſtion; which is the Inconvenience of Afternoon-ſleeps. Sleep alſo in the Morning, after taking ſomewhat of eaſy Digeſtion; as Milk from the Cow, nouriſhing Broths, or the like; promotes Nutrition: but this ſhould be done ſitting upright; that the Fluid may paſs the more ſpeedily to the bottom of the Stomach.

16. The *fourth* Means is, *to provide that the Parts themſelves may attract the Nouriſhment ſtrongly.* *Ariſtotle* excellently obſerves, that *a great reaſon why ſome Plants ſurvive living Creatures, is becauſe they yearly put forth new Leaves, and Boughs; whereas, living Creatures, after their period of Growth, put forth nothing that is young, but Hair and Nails; which are Excrements, and no Parts.* And it is certain, that whatſoever is young draws Nouriſhment better than what is old: but the Pith of the Obſervation is this, that *the young Boughs, and Leaves, drawing the Sap up to them, the Sap thus nouriſhes the Body in its Paſſage.* This we find remarkably illuſtrated in the frequent Cutting, or Trimming of Hedges, Trees, and Herbs; which conduces much to their Duration. The Obſervation ſhould, therefore, be transferred to the promoting of Nutrition in living Creatures: the nobleſt and principal Uſe whereof is, for the *Prolongation of Life*; the *Reſtoration of Youth, in ſome degree*; and mollifying of the Parts of the Body. For there are ſome Parts in Animals, that are eaſily nouriſhed and repaired; but others, with greater Difficulty: and the Point of View is, to renew ſuch as are eaſy to nouriſh, that the others alſo may be refreſhed; and, as it were, made to imbibe Nouriſhment in the Paſſage. Draught-Oxen, put into good Paſture, recover the Fleſh of young Beef; and Men, after long emaciating Diets, grow plump, fat, and almoſt new Creatures: ſo that we may conclude, the *frequent and prudent Uſe of emaciating Diets, Purgings, and, perhaps, ſome kinds of Bleeding, to be a principal Means of prolonging Life, and reſtoring ſome degree of Youth:* for Death comes upon living Creatures, like the Torment of *Mezentius*; whilſt the more reparable Parts of the Body, as the Spirits, Blood, and Fleſh, die in the Embraces of the Parts leſs reparable; as the Bones, Tendons, and Membranes. The ſame Obſervation may be applied to the nouriſhing of emaciated Bodies: and therefore *gentle Friction draws on Nouriſhment*, by heating, and making the Parts a little hungry. This *Friction* ſhould be uſed in the Morning. It is alſo beſt done by the Hand, or a Piece of ſcarlet Wool, moiſtned with Oil of Almonds, that is mixed with a little Bay-ſalt, or Saffron. The Currying of Horſes conduces to make them fat, and ſleek [r].

(4.) *By promoting Attraction in the Body.*

17. The *fifth* Means of *converting the Nouriſhment to its proper Uſe*, is, *to promote the Act of Aſſimilation*; which is done by ſome outward Emollients, that

(5.) *Promoting the Act of Aſſimilation.*

[r] This whole Affair is more largely proſecuted in the *Author's Hiſtory of Life and Death*; whereof the Doctrine here delivered, may be conſtrued the Baſis: and ſerve as an eminent Inſtance of the *Deſign* and *Uſe* intended to be made of the whole *Sylva Sylvarum*, in furniſhing the Matter for numerous *particular Hiſtories*.

that make the Parts more apt to aſſimilate. For this purpoſe I have a compound Ointment, of an excellent odour; which, I call *Roman Ointment*. It is to be uſed between Sleeps; for it is in the latter Sleep, that the Parts chiefly aſſimilate [t]. The *Ointment* is prepared as follows:

18. *UNGUENTUM FRAGRANS, SIVE ROMANUM:*

The Sweet, or, Roman *Unguent.*

The Author's Roman Unguent.

Take of *Deer's Suet*, four Ounces; *Oil of ſweet Almonds*, two Ounces: ſet them upon a very gentle Fire; and ſtir them till they are melted. Add *Orrice Root*, and *Damaſk Roſes*, powdered, together, two Drams; of *Myrrh*, a Dram; of *Cloves*, a Scruple; of *Civet*, eight Grains; of *Muſk*, twelve Grains; of *expreſſed Oil of Mace*, two Drops; and as much *Roſe-Water* as ſuffices to keep the Unguent thin. Let all theſe be put together in a Glaſs; and ſet upon hot Embers, for the Space of an Hour, and ſtirred well with a Juniper Stick [v]. See the *Articles* FRICTIONS, HUNGER, and NOURISHMENT.

FRAGILITY.

The Cauſe of Fragility and Toughneſs.

Some Bodies are fragile, and others tough: ſome fragile Bodies break only where the Force is applied; ſome ſhatter into many Pieces. The *Cauſe* of Fragility is an Impotency to be extended [u]: whence Stone is more fragile than Metal; and ſo, *fictile Earth* is more fragile than *crude Earth*; and dry Wood, than green. The *Cauſe* of this Unaptneſs to Extenſion, is a Deficiency of Spirits; for 'tis the *Spirit* that promotes the Extenſion of Bodies: and this Indiſpoſition is ever concomitant with Poroſity, and Dryneſs in the tangible Parts. Tough Bodies have more Spirits, fewer Pores, and moiſter tangible Parts: whence Parchment, or Leather, will ſtretch; but Paper, not: and woollen Cloth will tenter; but linen hardly [x].

FRICTIONS.

The Advantage of Frictions over Exerciſe.

Friction makes the Parts more full and fleſhy; as appears not only in Men, but in the Currying of Horſes, *&c.* becauſe it draws a greater Quantity of Spirits, and Blood, to the Parts; and alſo attracts the Aliment more forcibly from within: again, becauſe it relaxes the Pores; and ſo makes better way for the Spirits, Blood, and Aliment: and laſtly, becauſe it diſſipates and digeſts any uſeleſs or excrementitious Moiſture, that lies in the Fleſh: all which conſpire to promote Aſſimilation. Frictions alſo fill up, and fatten the Body, more than Exerciſe; becauſe, in Frictions, the inward Parts

[t] 'Tis great pity, that the preceding *Doctrine* ſhould not have been better obſerved, and cultivated, by Phyſicians. To a Neglect in this Matter, the Imperfection we daily experience in Medicine, may be, in a good meaſure, attributed.

[v] This *Unguent* requires ſome Skill, to prepare it in the manner directed.

[u] This ſeems a convertible Term, rather than a Cauſe; but the Cauſe is cloſer attempted by what follows.

[x] See more to this purpoſe in Mr. *Boyle's Enquiry into the Origin of Forms in Bodies*; Dr. *Clarke's Notes* upon *Rohault's Phyſicks*; and the Writers upon *Metallurgy*.

Parts are at reſt; which, in Exerciſe, are often hurt and bruiſed too much [y]. See the *Article* EXERCISE.

FROST.

Of Mortification, by Cold.

In the cold Countries, if the Extremities of the Body be frozen and mortified, and the Perſon approaches a Fire, the Parts affected preſently rot off; becauſe the few Spirits remaining in thoſe Parts, are thus ſuddenly drawn out: and thence Putrefaction is completed. But Snow applied, does good; as preſerving thoſe Spirits that remain, till they can revive: beſides, Snow may have a *ſecret Warmth* [z]. Warm Water alſo proves ſerviceable; becauſe it opens the Pores by degrees, without working ſuddenly upon the Spirits. This Experiment may be transferred to the *Cure of Gangrenes*: but here, beware of a dry Heat; and uſe things that are Cooling, with an inward Warmth and Virtue of Cheriſhing [a]. See the *Articles* PUTREFACTION, and TRANSMUTATION.

FRUIT.

Attempts for producing Fruit without Core or Stone,

1. To produce *Fruit without Cores*, or *Stones*, requires abundance of Moiſture; for the *Core*, and *Stone*, are made of a dry Sap: and we ſee, 'tis poſſible to make a Tree yield only Bloſſoms, without Fruit; as, in Cherries, with double Flowers: much more Fruit, without Stone or Core [b]. *'Tis reported*, that the Cion of an Apple-Tree, grafted upon a Colewort-ſtalk, yields a large Apple, without a Core. 'Tis not improbable, if the inner Pith of a Tree were taken out, ſo that the Juice may riſe only by the Bark, this might work the Effect: for it has been obſerved, in Pollards, that if the Water get in at the Top, and they become hollow, they put forth the more. It is alſo *delivered for certain*, that if a Cion be grafted the ſmall end downwards; it will make the Fruit have little or no Core, or Stone [c]. See the *Articles* VEGETABLES, and VEGETATION.

[y] This is a very material Diſtinction; and ſhould be well regarded in Practice: thus, for example, Exerciſe in the Caſe of unſound Viſcera, might prove highly prejudicial; whilſt Friction might have all the good Effects, propoſed by Exerciſe, without any danger.

[z] That Snow may have a ſecret Warmth, ſeems countenanced by certain Phænomena and Obſervations; as making the Hands glow; preſerving Corn in the Ground, *&c.* See Mr. *Boyle's experimental Hiſtory of Cold.*

[a] It is obſervable, that the true Cauſes of *Gangrenes*, *Mortifications*, *Corruptions*, and all the Changes leading up to them; as Digeſtion, Chylification, Sanguification, beginning Putrefaction, the Generation of Pus, *Ichor*, and all the morbifick Humours; are very little enquired into: Whence no wonder, if *Medicine* and *Chirurgery* remain imperfect. If it might give any Light to this Affair, we would venture to ask, *whether the Body has not a Chemiſtry peculiar to itſelf; whereby all theſe Operations are ſilently brought about?* And, before the Anſwer is returned, let the Matter be well conſidered, and examined; at leaſt, in ſome one capital Change; as that of the *Aliment into Chyle*; that of the Chyle into Blood; thoſe of the Blood into ſpecificated Juices; and that of any of the Juices, or Blood itſelf, into *Pus*, &c.

[b] Let the Uſe of *Inſtances of Approach* be remembred here; and upon all the like Occaſions. See the *Novum Organum*, *Part* II.

[c] Theſe Conjectures ſhould not be eſteemed Impoſſibilities: for there are, doubtleſs, many extraordinary Diſcoveries ſtill to be made in Vegetation; as we ſee ſome very conſiderable ones

The Means of making Fruit ſweet.

2. Fruits grow ſweet, (1.) by rolling, or preſſing them gently with the Hand, &c. (2.) by Rottenneſs; as Medlars, Services, Hips, &c. (3.) by Time; as Apples, Wardens, &c. (4.) by certain particular Maturations; as by laying them in Hay, Straw, &c. and, (5.) by Fire; as Roaſting, Stewing, &c. (1.) The *Cauſe* of the *Sweetneſs* by rolling, and preſſing, is Emollition; which thoſe Operations properly introduce: as in beating of Stock-fiſh, &c. (2.) By *Rottenneſs*; becauſe the Spirits of the Fruit, thus gather heat, and thereby digeſt the harder Parts; for in all *Putrefaction there is a degree of Heat* [d]. (3.) By *Time*, and *keeping*; becauſe the Spirits of the Body always feed upon the tangible Parts, and attenuate them. (4.) By particular *Maturations*; becauſe of ſome degree of Heat. And, (5.) By *Fire*; becauſe 'tis the proper Work of Heat to refine, and incorporate; for all Sourneſs conſiſts in ſome Groſſneſs of the Body: and all Incorporation makes the Mixture of the Body more equal in the Parts; which conſtantly induces a milder Taſte [e]. See the *Articles* CONCOCTION, MATURATION, PUTREFACTION, TRANSMUTATION, and VEGETABLES.

G.

GENERATION.

Why ſome Creatures generate at all, and ſome at different Seaſons.

1. SOme Creatures generate but at certain Seaſons of the Year; as *Deer*, *Sheep*, *Rabbits*, &c. and moſt ſorts of *Birds*, and *Fiſhes*: others, at any time of the Year; as Man, and all domeſtick Creatures, as Horſes, Dogs, Cats, &c. The *Cauſe of Generation*, at all Seaſons, ſeems to be *Fullneſs*; for Generation proceeds from Redundancy. This Fullneſs ariſes either from the Nature of the Creature, if it be hot, moiſt, and ſanguine, or from plenty of Food. For the *firſt*; Men, Horſes, Dogs, &c. which breed at all Seaſons, are full of Heat and Moiſture. *Doves* are the fulleſt of Heat and Moiſture, among Birds, and therefore breed often; the tame Dove, almoſt continually. But *Deer* are melancholy, dry Creatures; as appears by their Fearfulneſs, and the Hardneſs of their Fleſh. *Sheep* are a cold Creature; as appears by their Mildneſs, and their ſeldom Drinking. Moſt Birds are of a dry Subſtance, in compariſon of Beaſts. *Fiſhes* are cold. For the *ſecond* Cauſe; *viz. Fullneſs of Food*; Men, Kine, Swine, Dogs, &c. feed full: and we ſee that thoſe Creatures which, when wild, generate ſeldom; generate often, when tame: which proceeds from Warmth, and Fullneſs of Food. The Rutting-time of Deer, is in *September*; for they require the whole Summer's Feed and Graſs, to make them fit for Generation: and if Rain come early, about the middle of *September*, they go to rut

ones have lately been. Conſult, in particular, the *French Memoirs*; and Mr. *Hales's Vegetable Staticks*.

[d] Is this univerſally true? In particular, does it extend to Animal Fleſh, in the caſe of Mortifications, &c?

[e] Theſe are noble Attempts at the *Diſcovery of Cauſes*: but let them be ſtill farther purſued.

rut ſomewhat ſooner; if Drought, ſomewhat later. So *Sheep*, in reſpect of their ſmall Heat, generate about the ſame time; or ſomewhat before. But, for the moſt part, Creatures that generate at certain Seaſons, generate in the Spring; as Birds and Fiſhes: the End of Winter, and the Warmth and Chearfulneſs of the Spring, preparing them for it [f]. Another Reaſon why ſome Creatures generate at certain Seaſons, is the relation of their time of Bearing, to the time of Generation; for no Creature goes to generate, while the Female is full, or employed in ſitting, or rearing her Young: and therefore, if the Eggs, or young Ones, be taken out of the Neſts of Birds; the Birds will fall to generate again, three or four times ſucceſſively.

2. Some Creatures remain a longer time in the Womb, and ſome a ſhorter. Women commonly go nine Months; the Cow, and the Ewe, about ſix; Does, about nine; Mares, eleven Months; Bitches, nine Weeks; but Elephants are ſaid to go two Years [g]. There are here two Enquiries belonging to Birds; *viz.* the Diſtance between the Treading, and the Laying of the Egg; and again, between the Laying, and the Hatching [h]. Among Birds, there is a leſs Difference of Time, than among other Creatures; yet ſome there is: for the Hen ſits but three Weeks; the Turkey-hen, Gooſe, and Duck, *&c.* a Month. The *Cauſe* of this Difference may be, either from the Nature of the Kind, or the Conſtitution of the Womb; that is, according as the Hardneſs, or Dryneſs thereof, concurs with the former Cauſe: for the Colt, the Fawn, and the Calf, have about four Years Growth; but Whelps, which come to their Growth within three Quarters of a Year, continue but nine Weeks in the Womb. As there is leſs Diverſity among Birds, in the Time of their bringing forth; ſo is there alſo, in the Time of their Growth: moſt of them coming to Maturity within a Year.

The different Time of Geſtation in different Creatures.

3. Some Creatures bring many young ones at once; as Bitches, Hares, Rabbits, *&c.* ſome ordinarily but one; as Women, Lioneſſes, *&c.* This may be cauſed, either by the Quantity of Sperm required, to produce one of that Kind; which, if leſs be required, may produce a greater Number; if more, a ſmaller: or, by the Partitions, and Cells of the Womb; which may ſeparate the Sperm [i].

The Cauſe why ſome Creatures bring forth many, or few, at a Birth.

4. Some Creatures are generated by Copulation between the Male and Female; ſome by Putrefaction; and many of thoſe by Putrefaction, afterwards procreate by Copulation [k]. The *Cauſe of all Vivification, is a gentle and*

The Generation of Creatures by Copulation, and Putrefaction.

[f] Let this Doctrine of Fullneſs be compared with that of Dr. *Pitcairn*, Dr. *Freind*, &c. with reſpect to the *Cauſe* of the *Menſes*; which they deduce from Plenitude, Laxity, or Moiſture, *&c.* See *Freind's Emmenologia*, and *Pitcarin's Elementa*.

[g] See the Account of Elephants in the *Philoſophical Tranſactions*, Numb. 277 and 358.

[h] See Dr. *Harvey*, *Highmore*, &c.

[i] This Enquiry may deſerve a farther Proſecution; notwithſtanding the preſent Doctrine of *Animalcula in Semine Maſculino*.

[k] Is there any certain, inconteſtible Inſtance of Generation by Putrefaction? This may prove a Queſtion not to be determined haſtily; and, perhaps, the proper Experiments for determining it, are, at preſent, little conſidered. Let, therefore, a Set of *proper Experiments* be

and proportionable Heat, working upon a glutinous and yielding Subſtance. The Subſtance being glutinous, produces two Effects: the *one*, that the Spirit is detained, and cannot break out; the *other*, that the Matter being gentle and yielding, is driven forward by the Motion of the Spirits, after ſome Swelling into Shape and Members. Therefore all Sperm, and all the Matter whereof Creatures are produceed by Putrefaction, have a Cloſeneſs, Lentor, and Tenacity. So that the Generation by *Sperm* only, and by *Putrefaction*, have two different Cauſes; *viz.* (1.) Creatures of an exact Shape, as thoſe procreated by Copulation, cannot be produced by a weak and caſual Heat; nor from a Matter which is not exactly prepared, according to the Species. (2.) There is a longer time required to the Maturation of perfect Creatures; for if the time of Vivification be long, the Spirit will exhale before the Creature is mature; unleſs it be included, where it may have a continuance of Heat, acceſs of Nouriſhment, and cloſeneſs to keep it from exhaling: and ſuch places are the *Matrices* of Females. Therefore all Creatures by Putrefaction, are of a more uncertain Shape; formed in a ſhorter time; and require not ſo perfect an Encloſure: tho ſome Cloſeneſs be commonly neceſſary [l]. See the *Articles*, CATERPILLARS, PUTREFACTION, and TRASMUTATION.

GLASS.

Sand of the Nature of Glaſs.

1. *'Tis reported*, that in the Valley near *Mount Carmel*, in *Judea*, there is a *Sand*, which has a great Affinity with *Glaſs*; inſomuch, that other Minerals laid in it, turn to a glaſſy Subſtance, without Fire: and again, that Glaſs put into it, turns to the *Mother-ſand* [m]. The thing is very ſtrange, *if true*; and may be cauſed by ſome natural Furnace, or Heat, in the Earth; yet they ſpeak not of any Eruption of Flames. It were proper to try, in Glaſs-works, whether the crude Materials of Glaſs, mixed with Glaſs already made, will not facilitate the making of the Metal, with leſs Heat [n]. See the *Article* TRANSMUTATION.

The Materials of Venice *Glaſs.*

2. The cryſtalline *Venice* Glaſs, is reported to be equal Parts of Stones from *Pavia*, by the River *Ticinum*; and of the Aſhes of a Weed, called by the *Arabs*, *Kali*, and gathered in a Deſart between *Alexandria* and *Roſetta*. 'Tis

be made, upon *animal Fleſh*, by means of *Putrefaction*; with the exacteſt care, to guard againſt Flies, and other Inſects, or their Eggs: and let the Judgment of the Experimenter remain unprejudiced by the preſent prevailing Syſtem of *Generation*. This is ſpoke from an Intimation of ſome extraordinary *Phænomena* in ſuch Experiments. See certain Papers upon the Subject, in the *Philoſophical Tranſactions*.

[l] This is a Subject of great importance; and to be diligently enquired into by farther Experiment and Obſervation. 'Tis a great Misfortune, that Men ſhould be apt to raiſe, and fix a Doctrine upon too few Experiments, (and run great Lengths with it; from whence 'tis hard to return) without waiting for a ſufficient Number, before they draw the Concluſion: this haſty kind of *Induction*, is highly prejudicial to Philoſophy.

[m] What is the Fact?

[n] It may, perhaps, paſs for an *Axiom*; "that all Converſions are forwarded by the Admixture of ſome Proportion of the Body intended." At leaſt, this is a very uſeful Rule, in artificial Operations; and capable, by right Application, of producing conſiderable Effects. It ſhould ever be remembred, that *Simile ſimili gaudet*. See the *Article* CONTRACTION.

'Tis by the *Egyptians* uſed, firſt for Fewel; then they cruſh the Aſhes into Lumps like a Stone; and ſo ſell them to the *Venetians* for their Glaſs-works [o].

3. Four things ſhould be tried upon *Glaſs*; *viz.* (1.) the Means to make it more cryſtalline; (2.) to make it more ſtrong againſt Falls, and Fire; tho it come not to the degree of Malleability; (3.) to colour it by Tinctures, equal to precious Stones; (4.) to make a compound Body of *Glaſs* and *Galletyle*, that ſhall have the Colour milky, like a *Chalcedon*; and be a Subſtance between Porcellane and Glaſs. *Of the Improvement of Glaſs.*

4. For the *firſt*; enquire exactly, the ſeveral Materials whereof the Glaſs in uſe is made; *viz.* Window-glaſs, *Normandy* and *Burgundy* Glaſs, Ale-houſe Glaſs, and *Engliſh* Drinking Glaſs: and conſider the Reaſon of its Coarſeneſs or Clearneſs; from thence to aſſign ſome Additions to the coarſer Materials, for raiſing them to the Whiteneſs, and cryſtalline Splendor of the fineſt ſort. *By making it, (1.) more cryſtalline,*

5. For the *ſecond*; we ſee Pebbles, and ſome other Stones, will cut as fine as *cryſtal*; which, if they will melt, may be a Mixture for *Glaſs*, and render it more tough and cryſtalline. Beſides, Metals will vitrify; and, perhaps, ſome Portion of the *Glaſs of a Metal*, mixed in the Pot of ordinary Glaſs-metal, will make the whole Maſs more tough. *(2.) Stronger.*

6. For the *third*; enquire into the Ways of making coloured *Window-glaſs*, ſuch as is tinged in the Pot; and not by Colours laid on. *(3.) By colouring it in the Pot.*

7. And *laſtly*; enquire of what Stuff *Galletyle* is made, and how the Colours in it are varied; and then conſider how to make the Mixture of Glaſs-metal, and that whereof I have ſeen an Example [p]. *And, (4.) by compounding it with other Matters.*

GLOW-WORMS.

The Nature of the *Glow-worm* is not hitherto well obſerved. They breed chiefly in the hotteſt Summer Months; and not in open Champain, but in Buſhes and Hedges. Whence, perhaps, their Spirit is very fine; and not to be ſubtilized but with the Summer Heats: and, by reaſon of the Fineneſs, it may readily exhale. In *Italy*, and the hotter Countries, there is a Fly they call *Lucciole*, that ſhines as the *Glow-worm*; and is, perhaps, the *flying Glow-worm*. But this *Fly* is chiefly found in Fens and Marſhes; tho they are not ſeen but in the heat of Summer: and Sedge, or other green of the Fens, affords as good Shade as Buſhes. Poſſibly the *Glow-worms* of the cold Countries, ripen not ſo far as to be winged [q]. See the *Articles* CATERPILLAR, LIGHT, PUTREFACTION, and VISION. *Of the Nature and Properties of the* Glow-worm.

GOLD.

[o] See this *Hiſtory* deduced and illuſtrated in *Neri's Art of Glaſs*; with Dr. *Merret's Notes*: or rather *Kunckel's Edition* of the ſame *Work*.

[p] Tho the *Art of Glaſs* may ſeem carried to a great height, there is ſtill room for Improvements in it. See Mr. *Boyle*, and M. *Homberg* upon the Subject. But ſome particular *Glaſs Men*, of late, have, perhaps, got a few valuable Secrets, that are not known to *Philoſophers* and *Writers*.

[q] They have been found winged in *England*, and ſhining in hot Weather. There are ſome curious Obſervations and Experiments upon the *Glow-worm*, in Mr. *Boyle's Philoſophical Works*; and the *Philoſophical Tranſactions*, particularly Numb. 72 and 176.

GOLD.

The Foundations of an Enquiry for the making of Gold.

1. The World has been much abuſed by the Opinion of making *Gold*. The *Work itſelf, I judge poſſible*[r]; but the Means hitherto propoſed for effecting it, are, in *Practice*, full of Error and Impoſture; and, in *Theory*, full of vain Imaginations. For to ſay, that Nature has an Intention to make all Metals *Gold*; that if ſhe were freed from Impediments, ſhe would perform her own Work; that if the Crudities, Impurities, and *Leproſities of Metals* were cured, they would become Gold; and, that a little Quantity of the Medicine, in the Buſineſs of *Projection*, will turn a Sea of the baſer Metal into Gold by Multiplication; all theſe are but *Dreams*: and ſo are many other ſuppoſed Grounds of *Alchemy*. To help the matter; the Alchemiſts alſo call in many Vanities from Aſtrology, Natural Magick, ſuperſtitious Interpretations of Scriptures, auricular Traditions, feigned Teſtimonies of ancient Authors, and the like. 'Tis true, they have brought to light many profitable Experiments; and thereby made the World ſome Amends: but we would treat the *Tranſmutation of Bodies*, and the *Experiments* concerning Metals and Minerals, ſo as to lay open the true Ways and Paſſages of Nature, which lead to this great Effect. And herein we commend the *Chineſe*, who deſpair of making *Gold*; but apply to the making of *Silver*[s]: for 'tis more difficult to make *Gold*, the moſt ponderous of Metals, than to make *Silver*, from *Lead*, or *Quickſilver*; both which are more ponderous than Silver: ſo that they need, rather, a farther degree of Fixation, than any Condenſation[t]. In the mean time, we will direct an Experiment for the Maturation of Metals, and, thereby, for turning ſome of them into Gold; for, we conceive, that a *perfectly good Concoction, Digeſtion, or Maturation of ſome Metals, will produce Gold*[v]. I knew a *Dutchman*, who had wrought himſelf into the belief of a great Perſon, by undertaking to make Gold: his Diſcourſe was, that *Gold might be made; but that the Alchemiſts over-fired the Work: for*, he ſaid, *the making of Gold required*

[r] So have moſt of the Philoſophers, who were well verſed, and intimately acquainted with the Ways and Works of Nature and Art; but a thing may be *poſſible* that is not *practicable*. Let the Doctrine, and Diſcoveries of Mr. *Boyle*, Dr. *Hook*, and Sir *Iſaac Newton*, be conſulted upon this Occaſion. A Summary of the ancient and modern Doctrine, upon this Subject, may be found in *Boerhaave's Chemiſtry*. It were, perhaps, leſs judicious, to conſult *Morhof* and *Becher* upon this Point; tho Men of extraordinary Parts, Learning, and Experience: but *M. Homberg* and Dr. *Stahl*, cannot ſo well be excepted to. However, the Matter is not to be decided by *Authorities*, but *Experience*.

[s] Conſult, upon this Occaſion, *Kircher's China Illuſtrata*; and the late Miſſionaries Letters, particularly thoſe of *Father le Compte*, &c. See alſo *Morhof's Polyhiſt. de Philoſophia Naturali Chinenſium & Indorum*.

[t] The Author ſeems to agree with ſome of the Moderns, that to make a Subſtance as ponderous as *Gold*, is to make *Gold*. But, is Gravity the *Form*, or eſſential, and conſtituent Property of Gold? and, muſt all the other Properties; as Yellowneſs, Fixedneſs, *&c.* follow, of direct Conſequence?

[v] On what precice and internal Knowledge of the conſtituent Parts of Metals, does this Rule, for Practice, depend? does it relate to their truly *Mercurial Part*? and has the Exiſtence of this Part been ſufficiently proved, by Experience, to the Senſes?

required a very temperate Heat; *as being, in Nature, a ſubterraneous Work, where little Heat comes*; *tho more required to the making of Gold than of any other Metal*; and therefore, *that he would do it with a great Lamp*; *which ſhould carry a temperate and equal Heat*: and, *that it was the Work of many Months.* The Device of the Lamp might be Folly; but the *Over-firing* now uſed; the *equal Heat* required; and making the Operation the Work of ſome time, are no bad Intimations.

2. The *firſt* Caution is, that a *temperate Heat be uſed*; for they are ever temperate Heats that digeſt and maturate. But here we mean, *temperate according to the Nature of the Subject*: for that may be temperate to Fruits, and Liquors, which will not work upon Metals. The *ſecond* is, that the *Spirit of the Metal be quickened* [u]; and the *tangible Parts opened*: for, without theſe two Operations, the Spirit of the Metal wrought upon, will not be able to digeſt the Parts. The *third* Caution is, that the *Spirits ſpread themſelves even*, to make the Parts cloſe and pliant. And this requires a Heat that does not riſe and fall, but continues equable. The *fourth* is, that *no part of the Spirit be emitted*; for, if the Spirit goes out, the Body of the Metal will grow hard and churliſh. And this may be prevented, partly by a due Regulation of the Fire; and partly by the Cloſeneſs of the containing Veſſel. The *fifth* Caution required is, that *Choice be made of the likelieſt and beſt prepared Metal for the Purpoſe*; as this will facilitate the Work. The *ſixth* and laſt Caution is, that *time enough be allowed for the Operation*: not to prolong Hope, as the Alchemiſts do; but to give Nature a convenient Space to work in.

The Rules, or Cautions, required in the Work; viz.
(1.) *A Temperate Heat.*
(2.) *A quickening of the Spirit.*
(3.) *Equal Diffuſion of the Spirits.*
(4.) *Detention of all the Spirit.*
(5.) *Choice of a proper Subject.*
(6.) *A due allowance of Time.*

3. Theſe Principles appear juſt and certain: we will next, therefore, derive a Trial out of them; which may be improved by farther Meditation. (1.) Make a ſmall *Furnace* for a temperate Heat; ſuch as may keep the Metal continually melted, and no more: this, above all things, importing to the Work [w]. (2.) For the Material, take *Silver*, which, in Nature, ſymbolizes moſt with Gold [x]: put in alſo, with the *Silver*, a tenth part of *Quickſilver* [y]; and a twelfth part of Nitre, to quicken and open the Body of the Metal: and let the Work be continued ſix Months, at the leaſt. (3.) I recommend alſo, ſome oily Subſtance to be thrown in at times; ſuch as they uſe in the recovering of Gold, which, by being long tortured with Separations, is become churliſh [z]: and this, to lay the Parts more cloſe and

An Experiment derived from the preceding Rules.

[u] What is the preciſe meaning of *quickening the Spirit of a Metal?* The Alchemiſts talk much of a *fermentative Motion*; and endeavour to illuſtrate the thing by the Effects of Yeaſt, on Wort. But 'tis very unſafe arguing by Analogy, in theſe Caſes; tho it may well deſerve the Enquiry, whether Metals have not a *Fermentation, ſui Generis*; in what preciſe manner *Amalgamation operates*; and whether a *running Mercury* does not, in a proper Senſe, contain a *metallic Spirit?*

[w] Suppoſe *Silver*, therefore, were the Metal to be wrought on; the Furnace ſhould have the ſame degree of Heat as a *Teſting-Furnace.*

[x] But not in Gravity: for *Quickſilver* and *Lead*, are ſpecifically heavier than *Silver.*

[y] Was the extremely Volatility of *Quickſilver* conſidered, in ordering this for an Ingedient; when the whole is to be expoſed to a Heat capable of keeping Silver fluid?

[z] There is Sagacity ſhewn in this particular Direction: and, perhaps, any unctuous vegetable, or animal Matter will ſuffice.

ſmooth; which is a principal matter. For *Gold* is the cloſeſt, and therefore the heavieſt of Metals; and likewiſe the moſt flexible and ductile. (4.) To make Gold from *Quickſilver*, is not to be expected; becauſe of the great Gravity of Gold: and again, becauſe *Quickſilver* will not endure a ſtrong Fire. Next to *Silver*, I ſhou'd think *Copper* were the fitteſt to be the Subject.

The Cauſes of the Properties of GOLD, *to be diſcovered in order to make it.*

4. *Gold* has great Gravity; Cloſeneſs of Parts; Fixation; Ductility, or Softneſs; is of a yellow Colour, and not ſubject to Ruſt. Therefore the *ſure way to make it, is to know the* CAUSES *of theſe ſeveral Natures*; and the *Axioms* concerning them[a]. For if a Man can make a Metal, that has all theſe Properties; let others diſpute whether it be *Gold* or no[b].

GRAVITY.

Different Effects of Gravity, above and within the Earth.

1. *It is affirmed*, as an uſual Experiment, that a Lump of Ore at the bottom of a Mine, may be raiſed by two Men; which, on the Surface of the Earth, requires the Strength of ſix. This Inſtance ſhould be tried to the full[c]: for it is probable, that the power of Gravity is weakened both far above, and deep within the Earth. The former, becauſe the *Appetite of Union* between denſe Bodies and the Earth, in regard to Diſtance, is more dull: the latter, becauſe the Body has, in part, attained its end, when deſcended to ſome depth in the Earth. But as for Motion to a Point, which was the Opinion of the Ancients, it is a mere Vanity[d].

Heavy Bodies ſuſtained by Water.

2. The Dead-Sea, which throws up *Bitumen*, is ſo glutted, that living Bodies thrown into it, bound, have been born up by it: which ſhews that all ſinking in Water proceeds from an over-weight of the Body, in reſpect of the Water; ſo that Water may be made ſtrong enough to ſupport Iron: of which I ſee no Uſe but *Impoſture*. All Metals, except Gold, ſwim upon Quickſilver, for the ſame Reaſon[e].

Weight acquired by Solution.

3. Weigh Iron, and *Aqua-fortis*, ſeverally; then diſſolve the Iron in the *Aqua-fortis*, and weigh the Solution; and you will find it weigh as much as the Bodies did aſunder: notwithſtanding a great waſte, by a thick Vapour that

[a] If a proper Set of ſuch *Axioms* were once procured, we might rationally expect either to effect this, and even much greater Matters; or elſe to know the preciſe Reaſons of their impracticability: As Sir *Iſaac Newton* has ſhewn why Teleſcopical Glaſſes muſt neceſſarily remain imperfect, unleſs we cou'd alter the Nature of Light, or the Laws of Refraction; and as we certainly know the *Cauſe* why Water will riſe but to a certain height in *Pumps*, and Mercury in the common Barometer. Theſe Enquiries having fallen into better Hands than the Enquiries about *Tranſmutations*; is, perhaps, the Reaſon, why the Diſcoveries in the former are more numerous, and better verified, than in the latter. See the *Articles*, ALTERATION, CONCOCTION, FIXATION and TRANSMUTATION.

[b] 'Tis an Axiom, or *indentical Propoſition*, that a Body having all the Properties of *Gold*, is *Gold*. For the Method of conducting all ſuch Enquiries, See the *Novum Organum*, Part II. Sect. I.

[c] Is the Fact verified to this Day?

[d] Bating for the Form of Expreſſion, does not this Paragraph intimate the Subſtance of the preſent *Doctrine of Gravity*; tho not the Ratio, or preciſe Line of Deſcent in heavy Bodies?

[e] Here is a Foundation for the modern Improvements in *Hydroſtaticks*, by an eaſy Tranſlation and Enlargement.

that iſſued during the Diſſolution: which ſhews, that the opening of a Body may increaſe the Weight. This was tried once or twice; but I know not whether there were any Error committed [f].

The Floating of Solids upon Fluids.

4. A Solution of two Drams of *Quickſilver*, in two Ounces of *Aqua-fortis*, will not ſupport a Flint, the ſize of a Nutmeg: yet, no doubt, to increaſe the weight of Water, will increaſe its power of ſupporting; as we ſee in Brine, which, when ſtrong, will bear an Egg [g]. But it ſeems that the weight of Quickſilver, above the weight of a Stone, doth not compenſate the weight of a Stone, above the weight of *Aqua-fortis*.

The different Motions of Bodies of different Gravities.

5. Two Bodies of unequal weight, as Wood and Lead, join'd together, being thrown out of the hand, with the light end foremoſt, will turn, and the heavier end get before; unleſs the Body be over long: for the denſer Body ſuſtains a ſtronger preſſure of Parts from the firſt Impulſe; which is the Cauſe of all violent Motion: and when the hinder part moves ſwifter, (as enduring leſs Preſſure) than the fore part can make way for it; the Body muſt needs turn over: becauſe it can thus more eaſily draw the lighter part forward [h].

6. *Galilæo* well obſerves, that if an open Trough of Water be moved faſter than the Water can follow; the Fluid gathers in a heap behind: which he ſuppoſes to be the cauſe of the *ebbing and flowing of the Sea* [i]; viz. becauſe the Earth moves faſter than the Sea. Which Theory, tho falſe [k], yet the firſt Experiment is true. The unequal preſſure of Parts, appears manifeſtly in this; that if you take a Body of Stone, or Iron, and another of Wood, of the ſame magnitude and ſhape, and throw them with equal Force; you cannot throw the Wood ſo far as the Stone or Iron. [l].

GROWTH.

The Acceleration of Growth and Stature in Man.

The *Acceleration of Growth*, or Stature, muſt proceed, either, (1.) from due Nouriſhment; (2.) the Nature thereof; or (3) the quickning and exciting of the natural Heat. (1.) As for the firſt; exceſs of Nouriſhment is hurtful; as making the Child to grow corpulent; or more in Breadth than Height: like Plants, which, if they ſpread much, are ſeldom tall. (2.) As for the *Nature of the Nouriſhment*; it ſhou'd not be too dry; whence Children in *Dairy Countries* grow taller than where they feed more upon Bread and Fleſh. There is alſo a *received Tale*; that boiling of Daiſy-Roots, which are great Dryers, in Milk, will make Dogs little. But ſo much is true; that an over-dry Nouriſhment, in Childhood, retards the Stature. The Nou-

[f] Compare this with an exact Trial of the ſame kind, in the *Philoſophical Tranſactions*, N° 331.

[g] See the *Article* CONTRACTION.

[h] Compare this with Sir *Iſaac Newton's Laws of Motion*.

[i] See the Author's Treatment of this Subject in the *Novum Organum*; and the *fifth* Part of his INSTAURATION.

[k] Is this Conjecture abſolutely falſe? See Sir *Iſaac Newton*, and Dr. *Halley* upon the Subject.

[l] This Subject has been proſecuted by many; but by few perhaps, to greater Advantage than by Sir *Iſaac Newton*.

riſhment muſt alſo be of an opening Nature; for that attenuates the Juices, and promotes the Motion of the Spirits upwards. (3.) As for the *quickening of natural Heat*; this muſt be effected chiefly by Exerciſe: and therefore, Childrens going to Shool, where they ſit long, hinders their Growth; whereas Country-People, that go not to School, are commonly of better Stature[l]. And again; Men muſt beware how they give Children any thing that is cold, in its Operation; for even long Sucking hinders both the Wit and Stature. It has been tried, that a Whelp fed with Nitre, in Milk, became very little; but extremely lively: for the Spirit of Nitre is cold. And tho Nitre be an excellent Medicine, in full grown Perſons, for the Prolongation of Life[m]; yet in Children and young Creatures, it hinders Growth; and all for the ſame Reaſon: Heat being requiſite to Growth. But after a Man is come to middle Age, Heat conſumes the Spirits; which the Coldneſs of the Spirit of the Nitre helps to condenſe and correct[n].

H.

HARDNESS *and* SOFTNESS.

The Cauſe of Hardneſs, and Softneſs, in Bodies.

SOME Bodies are *hard*, and ſome *ſoft*. *Hardneſs is cauſed chiefly* by the jejuneneſs of the Spirits; and their diſproportion to the tangible Parts: both which, if in a greater degree, make them not only hard, but fragile, and leſs capable of Preſſure; as Steel, Stone, Glaſs, dry Wood, *&c.* *Softneſs proceeds* from the great quantity of Spirits, and the more equal ſpreading of the tangible Parts; which thereby become more ſliding: as in Gold, Lead, Wax, *&c.* But ſoft Bodies are of two Kinds; the *one* eaſily giving way, without altering the Bulk by riſing in other places: as in printing of Wax, the Wax does not riſe, but only the depreſs'd part gives place; and the other remains as it was. The *ſecond* kind alters the Bulk in yielding; as Water, or other Liquors; which, if a Stone be thrown into them, eaſily give way: but then they riſe over; which is a *falſe yielding*; as being a yielding in place, and not in Subſtance[o].

HEAT.

Expedients to diſcover the Power of Heat, in occluſo.

1. Of all the Powers in Nature, *Heat* is the chief; both in the Frame of Nature, and in the Works of Art. It is likewiſe certain, that the effects of Heat

[l] How far is this verified by Experience?

[m] See the Author's *Hiſtory of Life and Death*.

[n] The Author does not appear to mean the Chemical *Spirit of Nitre*; but the native Spirit, naturally contain'd in the crude Salt. And certainly it deſerves a careful Examination, what are the true Virtues and Uſes of Nitre. Dr. *Stahl* and Dr. *Hoffman*, have begun the Enquiry; but the Phyſicians of *England* ſeem to neglect the Medicine: I know not whether from finding it of little Efficacy; or thro' want of Attention. The Author recommends it highly; and ſo do many Foreigners.

[o] See Mr. *Boyle's Eſſays upon Fluidity and Firmneſs*; *Volatility and Fixedneſs*, &c. and Sir *Iſaac Newton's Queries*, at the End of his *Opticks*. But the Subject ſeems to require a ſtill more exact and *practical Enquiry*.

Heat are moſt advanced, when it operates upon a Body without loſs, or diſſipation of the Matter; which always defrauds the Account: and therefore the power of Heat is beſt perceived in *Diſtillations*, performed in cloſe Veſſels and Receptacles [p]. Yet there is a higher degree; for however Diſtillations may keep the Body confin'd in Cells and Cloyſters, yet they allow it room to turn into Vapour; return into Liquor; and to ſeparate one part from another. So that Nature here expatiates, tho not at full Liberty; whereby the true and ultimate Operations of Heat are not attained. But if Bodies may be alter'd by Heat, and yet no ſuch Reciprocation of Rarefaction, Condenſation, and Separation, admitted; probably this *Proteus* of Matter, being held by the Sleeve, will undergo many *Metamorphoſes*. Take, therefore, a ſquare Veſſel of Iron, in form of a Cube; and let it have thick and ſtrong Sides [q]. Put into it a Cube of Wood, that may fill it quite cloſe; let it have a cover of Iron, as ſtrong as the Sides; and lute it well, after the manner of the Chemiſts. Then place the Veſſel within burning Coals, kept quick kindled, for a few Hours. Now take the Veſſel from the Fire; open it, and ſee what is become of the Wood [r]. I conceive, ſince all Inflammation and Evaporation are entirely prevented, and the Body ſtill turned back upon itſelf, that either the Wood will be converted into a kind of *Amalgama*; or that the finer part will be turned into Air; and the groſſer ſtick, as it were baked, upon the ſides of the Veſſel; being become a denſer Matter than the crude Wood itſelf.

2. For another Trial; put Water into the like Veſſel, ſtopped as before; but uſe a gentler Heat, and remove the Veſſel ſometimes from the Fire; and again, when cold, renew the heating; and repeat the Proceſs alternately, for a few times [s]: and if once the Water, which is one of the ſimpleſt of Bodies, be changed in Colour, Odour, or Taſte, after the manner of compound Bodies, there is a great Work effected in Nature; and a conſiderable Entrance made into ſtrange Changes of Bodies, and new Productions: as alſo a way opened to do that by Fire in a ſhort time, which the Sun and Age do in a long one. The Effects of this cloſe Diſtillation, *which is like the Wombs and Matrices of living Creatures, where nothing expires, nor is ſeparated*, may be admirable; tho without aiming to make the *Pigmies* of *Paracelſus*, or any ſuch prodigious Follies: but perhaps the Effects

[p] The Author ſeems to mean what the Chemiſts call *Circulation*, or Digeſtion; where the Subject riſes in Vapour, and is returned back upon itſelf.

[q] What is the DIGESTOR more than an obvious Improvement of this Contrivance? But who has purſued the Experiment, beſides M. *Papin*?

[r] There may be danger in the Trial, from the burſting of the Veſſel; unleſs a weaker part be purpoſely left at the Top, that ſhall give way ſooner than the Sides, and ſo the Exploſion, if any ſhou'd happen, be directed up the Chimney. The fear of this Accident has, perhaps, deterr'd many from making the Experiment; or, at leaſt, from applying it to Quickſilver, and other metallick Bodies. But Prudence, and mechanical Skill, may direct a Veſſel to be made, that ſhall not be liable to any fatal Contingency.

[s] This Experiment alſo may require ſome Caution, to prevent its proving miſchievous; for Water heated in Confinement, has a great exploſive Power. A skilful and wary Operator ſhou'd be, therefore, employ'd in theſe kinds of Experiments.

fects of this Heat, will be ſuch, as wou'd ſcarce be imagined, if the Force of it be entirely kept in [t].

The different HEATS *of* Fire *and* boiling Water.

3. *Fire* applied to burning Wood, makes it firſt luminous; then black and brittle; next, jagged; and thus reduces it to Aſhes: but *ſcalding Water* has none of theſe Effects. The *Cauſe* is, that by Fire the Spirit of the Body is firſt rarified, and then emitted; the Refinement and Attenuation whereof produces Light whilſt the Emiſſion produces, firſt Fragility, and next, Diſſolution into Aſhes: and this at the time that no other Body enters. But in *Water* the Spirit of the Body is not rarified ſo much; and beſides, part of the Water enters; which encreaſes the Spirit, and in ſome degree extinguiſhes it: whence hot Water will quench Fire. Again, in Bodies, where the *Water*, does not enter much, but only the Heat paſſes; we ſee, hot Water produces the Effects of Fire: thus there is ſcarce any difference between Eggs boil'd, and roaſted [u]; but in Fruit, and Fleſh, where the *Water* in ſome meaſure enters, the difference is much greater [v].

Of different Heats working the ſame Effects.

4. The *Heat of the Sun*, for ripening of Fruits, and the *heat of Vivification* in living Creatures, are both ſupplied by the *heat of Fire:* and the Heats of the Sun, and Life, are repreſented one by the other. To ſet Trees at the back of a Chimney, ripens the Fruit the ſooner. Vines drawn in at the Window of a Kitchen, have yielded Grapes a Month before other Vines. Stoves at the backs of Walls, produce Oranges here in *England*. Eggs are hatched by the warmth of an Oven. *And 'tis reported*, that the Oſtrich lays her Eggs under Sand; where the heat of the Sun hatches them [w].

5. The

[t] The Author has judiciouſly reaſoned up to the Experiment: which now alone muſt determine of the Fact. The uncommon Effects of a *ſlight* DIGESTOR, with a *ſmall degree of Heat*, employ'd in a few Subjects, might be ſufficient Encouragement to urge the Diſcovery; and preſs Nature cloſer, in a variety of Subjects. The Mine is open, and Chemiſtry expects Enrichment from it.

[u] Let the *Inſtances* wherein *hot Water* and *Fire* agree be ſought; and again, thoſe wherein they differ; and let them be ranged, or tabled, according to the Direction of the *Novum Organum*, Part II. Sect. I. where the general Method of conducting Enquiries is deliver'd. There are ſome particulars, for this purpoſe, to be found in the *Philoſophical Tranſactions*, and *French Memoirs*.

[v] The different Natures and Effects of different kinds of Heat, have been but little attended to; tho a very material Article in Chemical Operations: where it will, perhaps, be found, that the *Heat of Water* may perform Operations, which cou'd not be effected by the *Heat of Sand*, *& vice verſa*: and this, not becauſe they are different degrees of Heat, about which alone the common Chemiſtry ſeems to be concerned; but becauſe the Heats are of different Natures, or have different Properties. The Foundation for the Enquiry is here laid by the Author: and, if duly proſecuted, might give great Light to Chemiſtry, and Natural Philoſophy. Thus, in particular, may not *Vitriol* be purified, in an extraordinary manner, for certain purpoſes; by a repeated diſſolution of the Body, *per ſe*, in a Glaſs Veſſel, ſet *in Balneo Mariæ*, without any additional Moiſture within the Glaſs? And can this Operation be performed by the heat of a Lamp, Sand, Aſhes, naked Fire, or any other than a *moiſt Heat?* See *Philoſophical Tranſactions*, N° 103.

[w] This Paragraph is Correlative to the preceding; as containing *Inſtances wherein different Heats agree*; according to the Direction of the *Novum Organum*. And unleſs that Piece be well underſtood, and kept in Mind, the Reader cannot eaſily perceive the Tendency, and Merits of the preſent Work: which is not intended for Curioſity, Agreeableneſs, Amuſement, or

5. The Water of Wells is warmer in Winter than in Summer; ſo is the Air in Caves [x]: Becauſe in theupper Parts, under the Earth, there is a degree of Heat; (as appears in Veins of Sulphur, *&c.*) which, being ſhut up cloſe, as in Winter, is greater; but if it perſpire, as in Summer, leſs [y]. *Of ſubterraneous* Heat.

6. In *Peru*, and ſeveral Parts of the *Weſt-Indies*, tho under the Line, the Heats are not ſo intolerable as in *Barbary*, and the ſkirts of the Torrid Zone [z]. The CAUSES may be theſe; (1.) the ſtrong Breezes which the motion of the Air in *great Circles of the Earth* produces, refrigerate; whence the Noon in thoſe Parts is not near ſo hot, when the Breezes are great, as about nine or ten a-Clock in the Morning. (2.) The length of the Night, and the Dews thereof, which abate the Heat of the Day. (3.) The Continuance of the Sun, in reſpect of the Seaſon; for under the *Line* the Sun croſſes the Æquinoctial, and makes two Summers, and two Winters; but in the ſkirts of the Torrid Zone, it doubles, goes back again, and ſo makes one long Summer [a]. *Of the* HEAT *under the Equinoctial.*

7. The bottom of a Veſſel of boiling Water is not ſo hot, but that a Man may apply his Hand to it [b]: The CAUSE may be, that the moiſture of Water allays Heat where it touches; and therefore Moiſture, tho it paſs not thro' Bodies, without Communication of Subſtance; as Heat and Cold do; yet works manifeſt Effects, by its qualifying of Heat and Cold; as in the preſent *Inſtance* [c]. We ſee likewiſe, that Waters diſtill'd with a *Bath-heat*, differ much from Waters diſtill'd by direct Fire. So Pewter-diſhes with Water in them, do not eaſily melt; but without it, readily: nay, Butter and Oil, which in themſelves are inflammable, yet by virtue of their Moiſture have the like Effect [d]. *The Qualification of* HEAT *by Moiſtures.*

8. *Fire* and *Heat* have ſimilar Operations in numerous *Inſtances*. Heat dries Bodies that eaſily expire; as Parchment, Leaves, Roots, Clay, *&c.* ſo *The Relation betwixt Fire and Heat, in ſeveral Effects.*

or Pleaſure; but ſolely levell'd at the *Inveſtigation of Cauſes*; the *Diſcovery of Forms*; and the *production of Capital Effects*. To inculcate this more than once, may not be unſeaſonable; as Men appear but little acquainted with the *Thing* in general, or the direct Deſign, and immenſe Utility, of the *preſent Hiſtory*, in particular.

[x] *Viz.* With regard to the Body, and the Heat or Coldneſs of the Air without: but how ſtands the particular, with regard to the Thermometer, or other ſtill more exact Methods of Trial? See Mr. *Boyle*, in the Entrance of his *Hiſtory of Cold*; and the Pieces of M. *Amontons*, and others, in the *French Memoirs*.

[y] This Enquiry deſerves to be farther proſecuted. See Mr. *Boyle*'s Pieces of the *Subterraneal* and *Submarine Regions*, &c.

[z] I have heard the Fact atteſted by Travellers.

[a] See *Varenii Geographia Generalis*.

[b] This Experiment may be tried without danger of burning, provided the Water be made to boil ſtrongly; and the bottom of the Veſſel, in that State, be immediately clapt upon the hand, and not continued after the bubbling, or boiling Motion, of the Water ceaſes.

[c] Is there not ſome more deep and latent *Cauſe* of this Effect? For the bottom of the Veſſel will burn the Hand, after the Water ceaſes to boil: tho the Water, perhaps, now remains as moiſt as before.

[d] How are Pewter Veſſels affected, when ſet over the Fire with Fluid Bodies in them that are not moiſt, as Quickſilver, for Inſtance? To diſcover the true Natures of *Heat and Fire* are ſubtile *Enquiries*; upon which very great Matters depend. Sir *Iſaac Newton* has left us ſome conſiderable Hints for the Proſecution, in his *Queries* at the End of his OPTICKS.

ſo does *Time* or *Age* [e]. *Heat* diſſolves and melts Bodies that retain their Spirits, as in many Liquefactions; and ſo doth *Time* in ſome Bodies of a ſofter Conſiſtence: as appears in *Honey* and *Sugar*, which by Age grow more liquid; and in old Oil, which is always more clear, and hot in medicinal Uſe. *Heat* cauſes the Spirits to ſearch ſome Iſſue out of the Body; as in the Volatility of Metals [f]: ſo does *Time*; as in the Ruſt of Metals [g]. But generally Heat does that in a ſmall time, which Age doth in a long one [h],

Their different Operations in others.

9. Some Things which have paſſed the Fire, are ſofteſt at firſt, and by time grow hard; as Crumbs of Bread. Some are harder when they come from the Fire; and afterwards give, and grow ſoft again; as the Cruſt of Bread, Biſket, Sweatmeats, Salt, *&c.* For in thoſe things that grow hard with Time, the Operation of the *Fire* is a kind of melting: and in thoſe that grow ſoft with *Time*, the operation of the Fire is a kind of baking: and whatever the Fire bakes, *Time* in ſome degree diſſolves [i]. See the *Articles* AIR, COLD, and COOLNESS.

HICCUP.

Of the Cauſe and Cure of the HICCUP.

Sneezing has been obſerved to ſtop the *Hiccup*. The CAUSE may be, that the Motion of the *Hiccup* is a riſing up of the Breaſt, which ſneezing ſomewhat depreſſes; and diverts the Motion another way. The *Hiccup proceeds*, (1.) from fullneſs of Meat; eſpecially in Children; which cauſes an extenſion of the Stomach. (2.) It is alſo *cauſed* by acid Meats, or Drinks, pricking and vellicating the Mouth of the Stomach. This Motion is eaſed either, (1.) by a *Diverſion*, or (2.) a *Detention* of the *Spirits*: by *Diverſion*, as in Sneezing; by *Detention*, as in holding the Breath: which ſomewhat helps to ſtop the Hiccup. Putting the Perſon into an earneſt Study [k], does the like. Vinegar alſo, applied to the Noſtrils, or gargled in the Mouth, has the ſame effect; as being Aſtringent, and ſuppreſſing the Motion of the Spirits [l]. See the *Articles* SNEEZING and YAWNING.

HUNGER,

[e] By Time and Age we are here, perhaps, to underſtand no more than *Opportunity*: as length of Time has no direct Agency upon Bodies itſelf; only affords an opportunity for their being acted upon by the Air, with its ſeveral Ingredients; which proving a kind of Menſtruum, works upon, and tinges itſelf with, the finer Particles of Bodies; and ſo at length leaves them effete, or reduced to a kind of Calx, or *Caput Mortuum*: and thus are introduced Dryneſs, Rottenneſs, Corruption, Changes, and, poſſibly, Regenerations, or new Combinations, in all the ſublunary Bodies: for the *Sum of Matter* is ever the ſame.

[f] This may illuſtrate the preceding *Note*; as not Time, but the aqueous or corroſive Spirit, or ſome particular Power in the Air, ſeems to be the Cauſe of Ruſt.

[g] For all Metals, even Gold itſelf, is Volatile, with a ſuitable degree of Heat; as we ſee in the *Burning Concave*.

[h] And therefore Heat is a Capital Power in *Nature*.

[i] Here again we have the Foundation of a noble *Enquiry*, directly leading to the production of conſiderable Effects. But for the way of proſecuting it to purpoſe, conſult the *Second Part* of the *Novum Organum*.

[k] Or a ſudden Fright.

[l] Do the Cauſes here aſſign'd reach to that *Hiccup* in Compound *Fevers*, and other Diſeaſes; which is uſually accounted a fatal Symptom; and for which no certain Remedy is hitherto known?

HUNGER, *or* APPETITE.

The Appetite is excited chiefly by Things that are *cold* and *dry*; for Cold is a kind of Want in Nature, that calls for ſupply; and ſo is Dryneſs: therefore (1.) all Acids, as Vinegar, juice of Lemmons, *&c.* provoke the Appetite. And the Diſeaſe call'd *Appetitus Caninus* conſiſts in an acid Phlegm, lodged in the Mouth of the Stomach [m]. (2.) Again, the Appetite is moved by four Things; as theſe induce a Contraction in the Nerves placed at the Mouth of the Stomach: which is a great *Cauſe* of Appetite. (3.) But Onions, Salt, and Pepper, in baked Meats, provoke the Appetite by vellicating thoſe Nerves. (4.) Wormwood, Olives, Capers, *&c.* which participate of Bitterneſs, excite the Appetite by Abſterſion. So that there are *four principal* CAUSES *of Appetite*: viz. (1.) Refrigeration of the Stomach, join'd with ſome degree of Dryneſs; (2.) Contraction; (3.) Vellication; and (4.) Abſterſion; beſides *Hunger*, which is an emptineſs. And yet over-faſting often *cauſes* the Appetite to ceaſe; for, want of Meat makes the Stomach attract the Humours: and ſuch as are light and cholerick damp the Appetite moſt [n]. See the *Article* FOODS.

The Nature and Cauſes of APPETITE *in the Stomach.*

I.

IMAGINATION.

1. MEN are to be admoniſh'd, *not to reject Operations by the Tranſmiſſion of Spirits*, and the *Force of Imagination*; only becauſe the Effects ſometimes fail: for, as in *Contagions from Body to Body*, the Infection may be often received by the paſſive Body; but, by the Strength and good Diſpoſition thereof, be repulſed and thrown out, before it forms into a Diſeaſe; ſo much the rather in *Impreſſions from Mind to Mind*, or from Spirit to Spirit, the Impreſſion may be made; but, being encountered and overcome by the Mind, and the paſſive Spirit, produce no manifeſt Effect [o]. And therefore, theſe Impreſſions operate moſt upon weak Minds, and Spirits; as thoſe of Women; ſick Perſons; the Superſtitious and Fearful; Children

The Notion of the Tranſmiſſion of Spirits, and the Force of Imagination, not to be rejected.

[m] Is this certain? Perhaps no *Cauſes* in all *Phyſicks* are leſs known, than the true and proper *Cauſes of Diſeaſes*; which alone can direct the Phyſician: and without them, all is gueſs-Work, Diffidence, and Darkneſs. The improvement of Medicine, therefore, requires a thorough Enquiry into the *Cauſes* of *Diſeaſes*. See the *Article* MEDICINE.

[n] Perhaps it were not amiſs to begin the Enquiry for improving *Medicine*, with the Stomach; which diſtributes to other Parts the Supplies of Health and Sickneſs. The Foundations for ſuch an Enquiry are nobly laid by the Author; but few ſeem to have followed him cloſely, in the tracing of Nature, finding out her ways, and inveſtigating the Cauſes of Health and Diſeaſes. His *Hiſtory* of *Life and Death* affords an illuſtrious Example, for entring upon, and conducting, *medicinal Enquiries*.

[o] This may deſerve to be well conſider'd, as opening a new Scene in Nature: but let the Judgment be well guarded here, and not give way to Vanities, Superſtitions and Illuſions. The Buſineſs is to find out the Laws and ſecret Workings of Nature, by cloſe and attentive Obſervation; without coining any Thing.

Children, and young Creatures [p]. As for their want of Power upon Kings and Magiſtrates; it may be aſcribed to the weakneſs of the Imagination, in the Imaginant: for 'tis hard for a *Witch* or a *Sorcerer* to put on a Belief, that they can hurt ſuch Perſons [q].

Nor too credulouſly believed.

2. Men are alſo to be admoniſhed, on the other hand, *that they do not eaſily give Credit to theſe Operations*; only becauſe they often ſucceed: for this Succeſs is frequently owing to the Force of *Affection*, and *Imagination*, upon the Agent; and operates by a ſecondary Means upon a different Body: for Example, if a Man wear a *Planet-Seal*, or a Bone-Ring, *believing ſtrongly* that it will help him to obtain his Miſtreſs; preſerve him unhurt in Fight; or the like; it may make him more active and induſtrious; more confident and perſiſting, than otherwiſe he would be. Now, we know, that the Effects of Induſtry and Perſeverance, eſpecially in civil Buſineſs, are great: For Audacity, in ſome meaſure, binds and conquers the weaker ſort of Minds; and the State of human Actions is ſo variable, that to try Things often, and never give over, works Wonders! It were therefore a Fallacy, and Miſtake, to aſcribe that to the *Force of Imagination, upon a foreign Body*, which is but the *Force of Imagination upon the proper Body:* for Imagination, and vehement Affection, work ſtrongly upon the Body of the Imaginant.

A third Admonition, not to miſtake the Fact.

3. Men ſhould alſo be admoniſhed, *not to miſtake the Fact, or Effect*; and raſhly conclude that done, which is not. For wiſe Judges do not haſtily believe the *Confeſſions of Witches*, nor the Evidence againſt them: the *Witches themſelves being imaginative*; and often believing they do what they do not: and *People are credulous in this Point*; and *ready to impute Accidents, and natural Operations, to Witchcraft.* 'Tis worth obſerving, that both in ancient, and later Times, the great wonders related of Witches flying in the Air, transforming themſelves, *&c.* are always ſaid to be wrought, not by *Incantations* or *Ceremonies*, but by *anointing themſelves all over: which may juſtly lead one to think, theſe Fables are the Effects of Imagination:* for Ointments ſtop the Pores, ſhut in the Vapours, and ſend them to the Head extremely. The particular Ingredients of theſe *magical Ointments*, are, probably, Opiate and Soporiferous: and anointing of the Forehead, Neck, and along the Back-Bone, is uſed for procuring deep Sleeps. If it be ſaid that this Effect is better procured by inward Potions; we anſwer that the Ingredients of the Ointment are ſo ſtrong, that if uſed internally, they might kill the Perſon; and therefore work powerfully as Externals [r].

The ſeveral ways wherein the Tranſmiſſion of Spirits, and the Imagination act, viz.

4. *All Operations by Tranſmiſſion of* Spirits, and by *Imagination*, operate at a *Diſtance, not in Contact*; and are as follows. (1.) The *Tranſmiſſion, or Emiſſion, of the thinner and more airy Parts of Bodies*; as in Odours and Infections: and this of all others is the moſt Corporeal. But there are many of

(1.) *By Aerial Effluvia.*

[p] *Neſcio quis teneros oculus mihi faſcinat* Agnos.

[q] Let Judgment be ſuſpended; at leaſt till the *Author* has been fully heard.

[r] Surely there is great Sagacity and Judgment ſhewn in deriving theſe Particulars; whilſt the Facts themſelves are ſteadily kept in View: inſomuch that a little farther proſecution of the Subject, might, perhaps, unravel the whole Secret of *Witchcraft*.

of these Emissions, both wholsome and unwholsome, that yield no Scent; as the Plague: and many wholesome Airs, as they appear to be by dwelling in them, and other Proofs, differ not in Smell from others. Under this Head, we rank all *Imbibitions of Air*, where the Substance is material, in the Form of Odour; some whereof are strange, and very suddenly diffused; as in the alteration which the Air receives in *Egypt*, upon the rising of the River *Nile* [s].

5. (2.) The *Transmission* or *Emission of what we call spiritual Species*; as the visible and the audible: which move swiftly, and to a great Distance; but then they require a Medium well disposed: and this Transmission is easily stopped [t]. (2.) *Spiritual Species.*

6. (3.) *The Emissions which cause Attraction of certain Bodies at a Distance*; as the Attraction of Amber, Jet, and other electrick Bodies; the Attraction of Gold, as to Quicksilver at a distance, [u] *&c.* (3.) *Attractions.*

7. (4.) *The Emission of Spirits, and immaterial Powers and Virtues, in those Things which work by the general Configuration and Sympathy of the World*; not by Forms, or celestial Influences, but by the primitive Nature of Matter, and the Seeds of Things. Of this kind is the Operation of the Loadstone [v], by Consent with the Globe of the Earth; the Motion of Gravity, by the Consent of dense Bodies with the Earth [w]; some disposition of Bodies to Rotation, and particularly from East to West; whence the principal Flux and Reflux of the Sea [x]; *viz.* by Consent of the Universe, as a part of the diurnal Motion. These immaterial Virtues have this peculiar Property, that the difference of Medium does not obstruct them; but they pass through all Mediums, tho at determinate Distances [y]. (4.) *Cosmical Qualities.*

8. (5.) *The Emissions of Spirits*, or *the Operation of the Spirits of the Mind upon other Spirits*: and this is of a double Nature; including the *Operations of the Affections*, if they be vehement; and the *Operation of the Imagination*, if it be strong. But these two are so coupled, that we must treat them together; for when an *envious*, or *amorous* Aspect infects the Spirits of another, the *Affection and Imagination are united* [z]. (5.) *The Spirits of the Mind.*

9. (6). The *Influences of the heavenly Bodies*, besides those two manifest ones of *Heat* and *Light*. (6.) *Celestial Influences.*

10. (7.) The *Operations of Sympathy*, brought by the Writers of *natural Magick* into an Art; which is, in order to superinduce any Virtue or Disposition in a Person, to chuse the living Creature, wherein that Virtue is most eminent; (7.) *The Operations of* Sympathy.

[s] See Mr. *Boyle's Treatise of Effluvia*, &c. particularly his *Memoirs for a general History of the Air.*

[t] See the *Articles* SOUND, and VISION.

[u] See the *Articles* ATTRACTION, and ELECTRICITY.

[v] See the *Article* MAGNETISM.

[w] See the *Article* GRAVITY.

[x] See the *Novum Organum.* Part II. Sect. I.

[y] See the several kinds of *Motions*: *Nov. Organ.* Part II. Sect. II. and the *Articles* NATURE, SPIRITS, and SYMPATHY.

[z] The subsequent part of the Discourse regards chiefly these two Particulars jointly. See below § 12, *&c.*

nent; of this Creature to take the Parts wherein that Virtue chiefly lies; and again to take these Parts in that Time and Act, where and when the Virtue is most exercised; and then apply it to that part of the Man wherein the same Virtue chiefly consists [a]. Thus for Example, *To superinduce Courage*; take a Lion, or a Cock; and chuse the Heart, Tooth or Paw of the Lion; or the Heart or Spur of the Cock: take these Parts immediately after the Lion, or the Cock, has been in Fight; and let them be worn upon a Man's Heart, or Wrist [b].

(8.) *The Sympathy of Individuals.*

11. (8.) The last *Operation* is an *Emission of immaterial Virtues*; such as we hesitate to propose, they are so prodigious; we mean the *Sympathy of Individuals:* for as there is a *Sympathy of Species*, so perhaps of *Individuals*, that is of Things, or the Parts of Things, which having been once contiguous or entire, there remains a Transmission of Virtue from the one to the other; as between the *Weapon* and the *Wound:* whence the Operation of the Weapon-salve, and Things of that kind, are blazed abroad [c].

The Emissions of Spiritual Species *which affect the Senses.*

12. The *Emissions* of *Spiritual Species* [d], should be treated under their proper Titles, of *Visibles* and *Audibles*, apart [e]: but there are some *general Observations* common to them both. Thus (1.) They both seem to be incorporeal. (2.) They work swiftly. (3.) They operate at great Distances. And (4.) In curious Varieties. (5.) They are not effective of any Thing; or leave no Works behind them; but are mere *Energies:* for their working upon Mirrors, and places of Echo, does not alter any thing in these Bodies; but 'tis the same Action with the Original, only reflected. The shaking of Windows; the percussion of the Air by loud Noises; and the Heat caused by Burning-glasses; are rather Concomitants than Effects of the *audible* and *visible Species.* (6.) Lastly, They seem of so tender and weak a Nature, as to affect only such an attenuated Substance as the Spirit of living Creatures.

The Emission of immaterial Virtues from the Minds and Spirits of Men, by Affections, Imaginations, and other Impressions.

(13.) *'Tis reported*, that when Children have been exposed, or taken away young from their Parents; and afterwards came into their Parents Presence unknown; the Parent has felt a secret Joy, or other Alteration, upon it [f]. An *Egyptian* Soothsayer made *Antony* believe that his Genius, tho otherwise brave and confident, was, in the Presence of *Octavius Cæsar*, poor and cowardly; and therefore advised him to absent himself. The Soothsayer was thought to be suborn'd by *Cleopatra*, to make *Antony* live in *Egypt*. However, the Opinion of a *predominant*, or *mastering Spirit* of one Man over another, is ancient, and still received, even in vulgar Opinion [g]. There are

[a] See the *Article* SYMPATHY.

[b] Let not the Author here be consider'd otherwise than as an Enquirer: it were very hard if a Philosopher were to be thought tainted with all the Superstitions he is obliged to examine. See hereafter § 22.

[c] See the *Article* NATURE, SPIRITS, and SYMPATHY. See also the *de Augmentis Scientiar.* Sect. VIII. 7. and the *Fable of Proserpina* in the *Sapientia Veterum.*

[d] See above, §. 5.

[e] As they are under the *Articles* SOUND and VISION.

[f] Let the Fact be fully enquired into.

[g] Every Man has it in his Power to examine this Matter: and are we not all affected in this manner? Have not some certain Persons an awe upon us, not only in Courts of Justice, and

are Opinions abroad, that ſome Men of an ill and melancholy Nature, incline the Company where they come, to be dull and ſad; whilſt others of a jovial Temper, diſpoſe the Company to Mirth and Chearfulneſs: and again, that ſome Men are lucky to be in ones Company, or employ'd in Buſineſs; and others unlucky. And certainly, 'tis agreeable to Reaſon, that there ſhould be ſome *light Effluxes from Spirit to Spirit*, when Men are in Preſence one with another, as well as from *Body to Body*. It has been obſerved, that old Men, who loved young Company, and been continually therein, were long lived; their Spirits, as it ſhould ſeem, being recreated by their Company. Such were the ancient Sophiſts and Rhetoricians; that conſtantly had young Auditors and Diſciples; ſuch as *Gorgias*, *Protagoras*, *Iſocrates*, &c. who lived till they were an hundred Years old. So likewiſe did many of the Grammarians and School-maſters, as *Orbilius*, &c. [h]

The Operations of the Affections at a Diſtance.

14. *Audacity* and *Confidence* in Civil Buſineſs, have ſuch great Effects, that one may reaſonably ſuſpect, beſides the daring, earneſtneſs, perſiſting, and importunity, there ſhould be *ſome ſecret Binding* and *Stooping* of other Mens Spirits to ſuch Perſons [i]. The Affections make the Spirits more powerful and active; eſpecially thoſe that draw them into the Eyes; which are two: *Love* and *Envy* [k]. For *Love*; the Platoniſts hold, that the Spirit of the Lover *paſſes into the Spirit of the Perſons loved*; which cauſes the deſire of return into the Body whence it was emitted: whereupon follows that Appetite of Contact and Conjunction in Lovers. And 'tis obſerved, that the Aſpects which procure Love, are not Gazings, but *ſudden Glances and Dartings of the Eye*. *Envy*, which is call'd an *evil Eye*, ſeems to emit ſome malignant and poiſonous Spirits, that take hold of the Spirits of another; and is ſaid likewiſe to be of greateſt Force, when the caſt of the Eye is oblique. This Paſſion has alſo been noted as moſt dangerous, when an envious Eye is caſt upon Perſons in Glory, Triumph, and Joy: becauſe at ſuch Times the *Spirits* come moſt into the outward Parts; and ſo meet the Percuſſion of the envious Eye. And it has been obſerv'd, that after great Triumphs, Men have been ill-diſpos'd for ſome Days. The Opinion of *Faſcination* is ancient and noted, for both Effects; *viz.* for procuring *Love*, and *Sickneſs* from *Envy*; and *Faſcination is ever by the Eye* [l]. Yet if there be any ſuch Infection from Spirit to Spirit; no doubt it works by Preſence, and not by the Eye alone; tho moſt forcibly by the Eye [m]. *Fear* and Shame are likewiſe infectious: the ſtarting of one Perſon, will make another ready to ſtart; and when a Man is out of Countenance, in Company, others bluſh with him.

15. Thoſe

the Courts of Princes, but in common Converſation? And does not our Spirit ſtoop, or ſtrike Sail as it were, to one Man more than another? And this as well from having only heard his Character, as being in his Company? Theſe Particulars ſhould not be ſlightly paſſed over; if they are Phænomena in Nature.

[h] See the *Author's Hiſtory of Life and Death*.

[i] See the Author's Eſſays upon *Ambition*, *Anger*, *Boldneſs*, *Nature in Men*, *Vain-Glory*, &c.

[k] See the Author's *Eſſays* upon *Love* and *Envy*.

[l] *Neſcio quis teneros* Oculus *mihi* faſcinat *Agnos*.

[m] Do not we all form our Conjecture, how a Perſon ſtands affected to us, from the Eye?

The Force of Imagination, imitating that of Senſe.

15. Thoſe Effects which are wrought by ſtriking the Senſes, and by things in fact, are likewiſe produced, in ſome degree, by the *Imagination*: thus, if a Man ſee another eat ſour things, which ſet the Teeth on edge; this Object taints the Imagination, and ſets his Teeth alſo on edge, by *Aſpect*. So if a Man ſee another turn long, and ſwiftly; or if he look upon Wheels that turn; himſelf grows giddy. So if a Man be upon a high Place, without Rails, or good Hold, unleſs he be uſed to it, he is ready to fall: for, *imagining a Fall, it puts his Spirits into the very Action of a Fall.* So upon ſeeing others bleed, or ſtrangled, or tortured, many are ready to faint; as if themſelves bled, or ſuffered [n].

A Specimen of a ſtrict Enquiry into the Force of Imagination *upon other Bodies; and the Means to ſtrengthen it.*

16. We come next, to conſider the *Force of Imagination upon other Bodies*, and *the Means to exalt and ſtrengthen it.* By *Imagination* we here underſtand *the Repreſentation of an individual Thought.* 'Tis of three kinds: the *firſt*, joined with Belief of what is to come: the *ſecond*, joined with a Conſciouſneſs of what is paſt: and the *third* regards things preſent, or as if they were preſent; for, under this, we comprehend *feigned Imaginations:* as if one ſhould imagine ſuch a Man veſted as a Pope; or to have Wings, *&c.* We ſingle out, for the preſent, that Species attended with *Faith*, or *Belief of what is to come.* The Enquiry into this Subject, by *Induction*, is extremely difficult; becauſe the things reported are full of Fables; and new Experiments can, in this Caſe, hardly be made, but with extreme Caution [o].

The Power of Imagination of three kinds.

17. The *Power of Imagination* is of *three kinds*; the *firſt* upon the Body of the Imaginant; including likewiſe the Child in the Womb: the *ſecond* is, the Power of it upon inanimate Bodies; as Plants, Wood, Stone, Metal, *&c.* and, the *third* is, its Power upon the Spirits of Men, and living Creatures. And this laſt ſhall be our preſent Subject.

Whether ſtrong Belief has any Efficacy in procuring the thing believed.

18. The *Problem* is, *whether a Man's conſtant, and ſtrong Belief, that ſuch a thing ſhall be*; *as, that ſuch an one will love him*; *or that ſuch an one will grant his Requeſt*, or the like, *has any Force in procuring the thing itſelf.* And here, again, we muſt warily diſtinguiſh; for 'tis not meant, that this *Belief* ſhould aſſiſt, by making a Man more reſolute or induſtrious; in which Caſe, a conſtant Belief has a great Effect; as was above obſerved; but *merely by a ſecret Operation*; as *by binding, or changing the Spirit of another.* And here it is hard to make any new Experiment; for *I cannot command my ſelf to believe what I pleaſe* [p]: and ſo, no Trial can be made. Nay, 'tis worſe; for *whatever a Man imagines doubtingly, or with fear, muſt needs do hurt*;

[n] Might not, therefore, conſiderable Effects be wrought by working, properly, upon the Imagination? whence, could not this Art be improved and advantageouſly introduced into Medicine? And *Query*, whether the remarkable *Cures* performed by Operators for Worms in the Gums, Tongue, *&c.* are not owing to this Cauſe? See the *Philoſophical Tranſactions*, Numb. 213, *&c.*

[o] The Author, probably, choſe to begin this Enquiry, upon account of the great Difficulties wherewith it is attended: according to his Intenſion, expreſſed in the Introduction to this Piece of *Sylva Sylvarum*, and followed in ſeveral Inſtances; as, particularly, in his Enquiry into *Life and Death*; *Winds*, &c. tho he has alſo a great regard to Utility, in all his Enquiries.

[p] This deſerves a particular Attention on ſeveral Accounts.

burt; if Imagination have any Power at all: for a Man oftener repreſents to himſelf the things he fears, than the contrary.

The Method of working by a ſecond Perſon, in the Buſineſs of Imagination, illuſtrated by Example.

19. The only Means is, therefore, to work by another Perſon in whom Belief may be created, and not by ones ſelf; till one has found, by Experience, that *Imagination* prevails; for then *Experience works Belief in ones ſelf*; if the Belief, that ſuch a thing ſhall happen, be joined with the Belief that ones Imagination may procure it. For example; I once related to a Man, curious and vain enough in theſe Matters, that I ſaw a Juggler, who having a Pack of Cards, would tell another what Card he thought of. My pretended Man of Learning told me, I was miſtaken; for, ſaid he, it was not the Knowledge of the Perſon's Thought; but the enforcing of a Thought upon him, and binding his Imagination by a ſtronger; ſo that he could think of no other Card. And thereupon he aſked me a Queſtion or two, which I thought he did craftily, as knowing before-hand the uſual Feats of the Juggler; and particularly, whether I remembred, if himſelf told the Card the Man thought; or bid another tell it? I anſwered, the latter. Whereto he replied; ſo I thought: for *himſelf could not have put on ſo ſtrong an Imagination*; but by telling the other the Card, who believed that the Juggler could do ſtrange things, the third Man *caught a ſtrong Imagination*. I hearkened to him, thinking, for a Trifle, he ſpoke prettily. Then he aſked, if I remembred whether the Juggler bid the Man think the Card firſt, and afterwards told the other, in his Ear, what he ſhould think; or whether he whiſpered in the Man's Ear who ſhould tell the Card, ſaying, that *ſuch a Man ſhould think ſuch a Card*; and, after, bid the Man think a Card? I anſwered, he firſt whiſpered the Man in the Ear, that ſuch a Man ſhould think ſuch a Card. Upon this, my learned Gentleman ſtrangely exulted, and pleaſed himſelf, ſaying, *you may ſee my Opinion is right*: for if the Man had thought firſt, his Thought had been fixed; but the other imagining firſt, bound his Thought. Which, tho it did ſomewhat ſink with me, yet I made light of it, and ſaid; *I thought it was Confederacy between the Juggler and the two Servants*: tho, indeed, I had no reaſon to think ſo; for they were both my Father's Servants: and the Juggler had never played in the Houſe before. This Juggler alſo cauſed a Garter to be held up; and took upon him to know, that ſuch an one ſhould point in ſuch a place of the Garter, as ſhould be ſo many Inches to the longer End, and ſo many to the ſhorter; and ſtill he did it by firſt telling the *Imaginer*, and afterwards bidding the *Actor* think.

Three Means of fortifying Belief; viz. Experience, Reaſon, *and* Authority.

20. This Relation is not here given for its Dignity; but becauſe it opens the nature of the Queſtion; and ſhews, that *Experiments of Imagination* muſt be practiſed upon others, and not upon a Man's ſelf. For *there are three Means of fortifying Belief*; viz. *Experience, Reaſon, and Authority*; the more powerful of which, by much, is Authority: for *Belief upon Reaſon, or Experience, will ſtagger* [1]. *Authority* is of two kinds; Belief in an Art; and Belief in a Man. As for Matters of Belief in an Art; one may exerciſe them

[1] Here ſeems to lie a conſiderable Secret.

them by ones ſelf; but Belief in a Man, muſt be by another: therefore, if a Man believe in Aſtrology, and find a Figure proſperous; or believe in natural Magick; as, that a Ring wore with ſuch a Stone, will do good; this may help his Imagination. BELIEF PLACED IN A MAN IS FAR MORE ACTIVE: yet, ALL AUTHORITY MUST BE FROM ONES SELF, turned either upon an Art, or upon a Man: and *where Authority is from one Man to another, the ſecond muſt be ignorant, and unlearned, or full of Thoughts*; and ſuch generally are Witches, and ſuperſtitious Perſons; whoſe Beliefs, tied to their Teachers and Traditions, are not controlled, either by Reaſon or Experience: and hence, in *Magick*, they commonly chuſe Boys, and young People; whoſe Spirits eaſieſt take *Belief* and Imagination [r].

Three Ways of fortifying the Imagination; viz. (1.) By Authority. (2.) Quickening the Imagination.

21. There are *three Ways of fortifying the Imagination*; viz. (1.) by *Authority*, whence the Belief is derived; (2.) by *quickening, and corroborating the Imagination*; and, (3.) by *repeating, and refreſhing it*. The Buſineſs of *Authority* has been ſpoke to already: and for the *Means of quickening and corroborating the Imagination*; we ſee what is uſed in *Magick* (*if in ſuch Practices there be any thing purely natural*;) viz. *Veſtments, Characters, Words, Seals*; *certain Parts of Plants*, or *Animals*; *Stones*; *Choice of the Hour*; *Geſtures*, and *Motions*; *Incenſes*, and *Odours*; *Choice of Society*, which increaſes Imagination; *Diets*, and *Preparations for ſome time before-hand*. And, for Words; there have been always, either barbarous ones, and of no Signification, leſt they ſhould diſturb the Imagination; or Words of Similitude, to ſecond and feed it: and this, as well in *heathen Charms*, as thoſe of later times [s]. They alſo uſe *Scripture Words*; *for the Belief that religious Texts, and Words, have Power, may ſtrengthen the Imagination.* And, for the ſame reaſon, *Hebrew Words*, which, with us, are accounted more holy and myſtical, are often uſed for this purpoſe [t]. For *refreſhing the Imagination*; which is the *third Means* of exalting it; we ſee the Practices of Magick, in Images of Wax, and the like, that are to melt by degrees; and ſome other things buried, to putrefy gradually in the Earth: *for as often as the Imaginant thinks of theſe things, ſo often does he repreſent to his Imagination the effect deſired.*

And, (3.) refreſhing it.

How the Imagination may phyſically operate to great Diſtances.

22. *If there be any Power in Imagination*, 'tis leſs credible it ſhould be ſo incorporeal and immaterial a Virtue, as to operate at great Diſtances; though

[r] Theſe Particulars ſeem deduced with great ſtrength of Judgment; and lay a ſolid Foundation for a noble Practice, eſpecially in the Buſineſs of Education; whereby Men might ſurely be formed to much greater Advantage than in our preſent Methods. The Education of the *Chineſe* may be worth enquiring into upon this Occaſion.

[s] Obſerve, the Author has not forgot his own Caution of guarding the Infancy of Philoſophy againſt Fables, Fancies, and Fictions; tho, he judges, that all ſuperſtitious Ceremonies ſhould be carefully examined, after Philoſophy has gathered Strength; and, therefore, all along takes care to *ſow the Seeds* of ſuch Enquiries, that they may be farther cultivated, in future Ages.

[t] It may deſerve enquiring, how many of theſe Particulars have been introduced, and with what Alterations, and Succeſs, into *falſe Religions*. Are not *Relicks, Images, Incenſe, horary Maſſes*, certain *Geſticulations, Probations*, and ſome particular *Words*, and *Phraſes*, things of this Stamp?

through all Mediums; or upon all Bodies: tho it is required, that the Diſtance be competent; the Medium not contrary; and the Body apt and proportionate. Therefore, *if there be any Operation upon Bodies abſent by Nature*, 'tis likely to be conveyed from Man to Man, as *Fame* is: ſo, for example, if a Witch, by Imagination, ſhould hurt any one a far off, it cannot be naturally; but by working upon the Spirit of one that comes to the Witch; and from thence upon the Imagination of another; and ſo another; till it arrive at the Perſon intended. And altho they ſay it ſuffices to take a Pin, or a Piece of the Garment, or the Name of the Party, *&c.* little Credit can be given to ſuch things; *unleſs it be by the working of evil Spirits* [v].

23. The Experiments that *certainly* demonſtrate the Power of the *Imagination* upon other Bodies, *are few, or none:* for the *Experiments of Witchcraft are no clear Proofs*; becauſe they *may be* by the tacit Operation of *evil Spirits.* We are therefore obliged, in this Enquiry, to uſe new Experiments; wherein, however, we can furniſh only Directions, and not any poſitive Trials. For, indeed, we give ſo little Credit to *theſe Effects of Imagination upon other Bodies*, that we ſhall only try them at leiſure: but, in the mean time, are willing to lead others the way.

No Experiments extant, that demonſtrate the Power of Imagination upon other Bodies.

24. (1.) To work by the Imagination of another, 'tis neceſſary that he, by whom you work, ſhould have an *Opinion of you*; as, that you can do ſtrange things; or are a *Man of Art*, as they call it: otherwiſe, the ſimple Affirmation to another, that this or that ſhall be, makes but a weak Impreſſion on his *Imagination.* And, as we cannot fully diſcern the Strength of *Imagination* in one Man more than another, it were proper to try the *Imaginations* of ſeveral; in order to light upon a ſtrong one: as if a Phyſician ſhould tell three or four of his Patient's Servants, that their Maſter would certainly recover [u].

Indications of new Experiments for the Purpoſe.

(1.) *By* Opinion.

25. (2.) The Minds of Men are ſo various, that the Imagination of him you would uſe, cannot be always alike conſtant and ſtrong; and if the Succeſs follow not ſpeedily, the Operation will languiſh. To remedy this, you muſt pretend to him whoſe Imagination you uſe, ſeveral degrees of Means by which you operate; as to order him, every three Days, if he find not the Succeſs apparent, to uſe another Root, part of a Beaſt, or Ring, *&c.* as being of more Force; and if that fail, another; and if that, another; till *ſeven times.* You muſt alſo preſcribe a good length of Time, for the promiſed Effect; as to tell the Servant his Maſter ſhall recover; but it will be *fourteen Days* before he finds it apparently, *&c.* All this, to entertain the *Imagination*, that it waver leſs.

(2.) *By Pretence of various Means, in Sequence.*

26. (3.) 'Tis certain, that Potions, or things taken into the Body; Incenſes and Perfumes received at the Noſtrils; and anointing of ſome Parts, natu-

(3.) *By Unctions, Perfumes, &c.*

[v] If once *evil Spirits* are admitted, there is an End of *ſtrict philoſophical* Enquiry; and the Cauſe is removed to a different Court. See the *De Augmentis Scientiarum*, Sect. XXVIII.

[u] If there be no Immorality, Treſpaſs upon Religion, Senſe, good Manners, or Conſcience, in ſuch a Procedure, where is the Harm of trying it? See below, § 27.

naturally work upon the Imagination of him who uſes them: therefore it muſt needs greatly co-operate with the Imagination of him you uſe, to preſcribe him, before he enters upon the Receipt, for the Work he deſires, ſuch a Pill; or a Spoonful of Liquor; to burn ſuch an Incenſe; or anoint his Temples, or the Soles of his Feet, with ſuch an Oil or Ointment: and you muſt chuſe, for the Compoſition of ſuch Pills, Perfumes, or Ointments, Ingredients that make the Spirits a little more groſs, or thick; whereby the *Imagination* will fix the better [v].

(4.) *By a proper choice of Times.*

27. (4.) The *Body to be wrought upon, is better affected at ſome certain times, than at others*; as if you ſhould order a Servant, whom you have poſſeſſed that his Maſter ſhall recover, to uſe ſuch a Root, or ſuch a Root; when his Maſter is faſt aſleep: for Imagination is likely to operate better upon Men aſleep than awake; as appears by Dreams [x]. In the *Art of Memory*, viſible Images work better than other Conceits: thus, if you would remember the Word *Philoſophy*, you ſhall better do it by *imagining*, that ſuch a Man *(for Men are the beſt Places)* is reading upon *Ariſtotle*'s Phyſicks; than by *imagining* one to ſay, *I'll go ſtudy Philoſophy*. This Obſervation, therefore, ſhould be transferred to the preſent Subject: *for the clearer the Imagination is, the better it fills and fixes*. Whence, probably, the *Experiment of binding Mens Thoughts* will prove leſs fallacious, upon telling a Perſon, that another ſhall name *one of twenty Men*, than *one of twenty Cards* [y]. And this *Experiment of binding the Thoughts*, ſhould be diverſified; and tried to the full: obſerving whether it ſucceed for the moſt part, tho not always.

(5.) *By operating upon the weakeſt Paſſions.*

28. (5.) 'Tis proper to conſider, upon what things the Imagination has greateſt Foree: and the Rule is, that *it operates moſt upon thoſe things which have the lighteſt and eaſieſt Motions*; and therefore, principally upon the Spirits of Men: and thoſe Affections that move the lighteſt; as in *procuring Love*; and *binding Luſt*: which Paſſions are always attended with *Imagination* of Fear, Irreſolution, and the like. Whatever is of this kind ſhould be thoroughly enquired into.

(6.) *The Enquiry to be extended to Plants, and other Matters ſuſceptible of light Motions.*

29. (6.) Diligent Trials ſhould likewiſe be made upon Plants: as if you ſhould tell a Man that ſuch a Tree will die this year; and require him, at certain times, to go and ſee how it fares. As for inanimate things; 'tis true, the Motion in ſhuffling of Cards, or throwing of Dice, is light: and there is a Folly very uſual with Gameſters, to imagine ſome By-ſtanders bring them Ill-luck. Trial alſo ſhould be made, of holding a Ring by a Thread in a Drinking-Glaſs, and, before-hand, telling him who holds it, that it ſhall ſtrike ſo many times againſt the Side of the Glaſs, and no more; or of holding a Key between two Mens Fingers, without a Charm; and to tell thoſe

[v] This Direction appears to be derived from the reputed Practices of Witches and Sorcerers: yet ſeems to have a good Foundation in Nature and Medicine. Both the ancient and modern Writers abound with the Names of Ingredients for this Purpoſe: but their Natures are not ſufficiently underſtood.

[x] For the Doctrine of Dreams, ſee the *De Augmentis Scientiarum*, Sect. VIII. See alſo, the Author's *Eſſay on Prophecies*.

[y] See above § 18.

thoſe who hold it, that at ſuch a Name it ſhall turn off their Fingers [z]: for theſe two are extreme light Motions. And tho I have no Opinion of theſe things, yet ſo much I conceive to be true; that *ſtrong Imagination* has more Force upon living Things, or which have been living, than upon Things merely inanimate: and again, more Force upon light and ſubtile Motions, than upon ſuch as are vehement, or in a ponderous Subject.

The Notion of a dead Body bleeding at the approach of the Murderer.

30. 'Tis an uſual Obſervation, that if the Body of one murdered, be brought before the Murderer, the Wounds will bleed a-freſh. Some affirm, that a dead Body, upon the Preſence of the Murderer, has opened the Eyes; and that there have been ſuch Motions, as well when the Parties murdered were ſtrangled, or drowned, as when they were killed by Wounds. And, *if this be natural*, it muſt be referred to *Imagination* [a]. So the *tying of the Point* upon the Day of Marriage, to make Men impotent, muſt, *if natural*, be referred to the *Imagination* of him that *ties* it. I conceive this to have the leſs Affinity with Witchcraft, becauſe not only particular Perſons, as Witches; but any other Perſon may do it [b]. See the next *Article* IMPOTENCY. See alſo the *Articles* SPIRITS, and SYMPATHY.

IMPOTENCY.

Impotency by Ligature, or tying of the Point.

In *Zant*, 'tis very common to make Men impotent: the like is practiſed in *Gaſcony*; and always upon the Wedding-day. But in *Zant*, the Mothers themſelves do it, by way of Prevention; becauſe they thereby hinder others Charms, and can undo their own. 'Tis a thing the *Civil Law* takes cognizance of; and therefore of no ſmall moment [c]. See the *Articles* IMAGINATION, and SYMPATHY.

IMPULSE, *or* MOTION.

The Nature of Impulſe and Percuſſion.

1. A ponderous Body put into Motion, is more eaſily impelled, than when

[z] Theſe Particulars are derived from the common ſuperſtitious Practices of *diſcovering a Thief*, &c. As by the *Sieve and Sheers*; the *Common-Prayer Book and Key*, &c. in which ſome People have great Faith.

[a] How is this to be underſtood? Is it poſſible the Imagination of the guilty Perſon, can be ſo far wrought upon by Prepoſſeſſion, ſtrong Belief, or conſciouſneſs of Guilt, as to make Blood flow from a Carcaſs, or open the Eyes of the Dead? The Author might well call this a *difficult Enquiry*, where it is ſo extremely difficult for the *Reaſon* to keep pace with the *Imagination*, and not be foiled by it. But to keep our *Reaſon* and *Judgment* clear, he prudently directs us to work with the *Imagination* of another.

[b] Some entire Parts of this general Enquiry remain unproſecuted by the Author; as how the *Fœtus* comes to be marked in the *Uterus*, &c. and the Part he touches upon, is not yet driven to any tolerable degree of Certainty and Preciſion; tho a thing of great Importance. And to conſider the general Procedure of Men, we ſhall not find it ſtrange, that no farther Diſcoveries are made in this, and the like Subjects: for the modern Method has uſually been, to turn *Enquiries* into *Diſputes*; and inſtead of purſuing Nature cloſe, by new Experiments, the Chaſe has been deſerted; and dwindled into ſingle Combats, Opinions, and Parties: Men thus affecting Victory over one another, more than over *Nature*.

[c] For the *Hiſtory* of this Affair, conſult Mr. *Chambers's Dictionary of Arts and Sciences*; under the *Article* LIGATURE.

when at Reſt [d]; partly becauſe Motion *diſcuſſes the Torpor* [e] of ſolid Bodies; which, beſide their Motion of Gravity, have a natural Appetite not to move at all [f]; and partly, becauſe a Body at reſt, acquires, by the Reſiſtance of the Body whereon it reſts, a ſtronger compreſſion of Parts, than it has of itſelf; and therefore requires more Force to put it in Motion: for if a heavy Body be ſuſpended by a Thread; Percuſſion will give an Impulſe very near as eaſily, as if it were already in Motion [g].

Impulſe requires Reſiſtance, or Weight in the moving Body.

2. A Body too large, or too ſmall, cannot be thrown ſo far as a Body of a middle ſize: ſo that there muſt be a Proportion between the Body moved, and the Force to move it ſtrongly; for *Impulſe* requires, not only Force in the moving Body, but Reſiſtance in the Body moved [h]: if the Body be too great, it yields too little; and if too ſmall, it reſiſts too little [i].

The Cauſe of Impulſe.

3. 'Tis found in common Experience, that no weight has ſo much Force, when laid upon a Body, as by falling from on high. I take the chief *Cauſe* to be, that the Parts of the Body moved, have, by *Impulſe*, or the *Motion of Gravity continued*, a Compreſſion in them, as well downwards, as when they are thrown, or ſhot thro' the Air forwards. I conceive alſo, that the Quickneſs of this Motion gains upon the Reſiſtance of the Body below: for priority of Force is always of great Efficacy; as appears from numerous *Inſtances* [k]. See the *Articles*, GRAVITY, and MOTION.

INCORPORATION.

The Incorporation of Powders, and Liquors.

Moſt Powders, as Meal, *&c.* grow cloſer, and more coherent, by the admixture of Water, than of Oil; tho' Oil be the thicker Body. The *Reaſon* is, from the Congruity of Bodies; which, if greater, makes a perfecter

[d] This expreſſes a Part of Sir *Iſaac Newton's ſecond Law of Motion*; viz. that *the Alteration of Motion is always proportionate to the moving Force impreſſed.*

[e] *Viz.* Overcomes their Force of Reſiſtance.

[f] This Sir *Iſaac Newton* expreſſes by the *Vis Inertiæ*, or Force of Inactivity in Matter.

[g] Here is a great Opening into the modern Doctrine of Motion, in general; and with regard to the Doctrine of Friction, in particular. See *Memoires de l'Academie Royale des Sciences, paſſim.*

[g] See Sir *Iſaac Newton's Axiomata*, or *Leges Motus*; in his *Philoſophiæ Naturalis Principia Mathematica.*

[h] 'Tis plain the Author means by *Impulſe*, the ſame that we now commonly call *Momentum*; or, in mathematical Language, a *Rectangle of the Velocity into the Weight of the Body*: ſo that the Senſe is, that in order to a great Stroke, or *Impulſe*, the Body muſt have a Weight proportionable to its Velocity. It will, doubtleſs, ſeem ſtrange to many, that the Author ſhould, a hundred Years ago, have ſeen ſo far into what are generally reputed *modern Doctrines*, and *Diſcoveries*. But the Way he came at them, was, by converſing with Nature; a Way that lies open to every one's Diligence.

[i] Is not here a direct Intimation of what Sir *Iſaac Newton* at firſt caſually obſerved, as to the *Power of Gravity*, and afterwards deduced; till, at length, he diſcovered this *Power* to be the *Cauſe* that keeps the Planets and Comets in their Orbs, *&c.*? See Dr. *Pemberton's Introduction* to his *View of Sir* Iſaac Newton's *Philoſophy.*

[k] How does this comport with Sir *Iſaac Newton's third Law of Motion*; viz. that *Action and Re-action are always equal?* It is a curious Speculation, and may deſerve to be ſtill farther proſecuted by Experiment. See the *French Memoirs*, paſſim.

fecter Imbibition and Incorporation: and this Congruity, in moſt Powders, is greater betwixt moſt Powders and Water, than betwixt Powders and Oils: but Aſhes, and Painters-Colours ground, incorporate better with Oil [l]. See the *Articles*, METALS, and MIXTURE.

INDURATION, *or* PETREFACTION.

Three Means of Induration, *or* Petrefaction *in Bodies*; viz. (1.) *Cold*: (2.) *Heat*. *And*, (3.) *Aſſimilation*.

1. *Induration*, or *Petrefaction* of ſoft Subſtances, are great *Alterations* in Nature: and effected by three Means; *viz.* (1.) by *Cold*; which has a Property of *Condenſing*: (2.) by *Heat*; which is not a proper, but a conſequential Effect: for Heat attenuates; and, by Attenuation, drives out the Spirit, and moiſter Part of a Body; whereupon the more groſs of the tangible Parts, contract and ſhrink together; both to avoid a *Vacuity*, as they call it; and alſo, to defend themſelves againſt the Force of Fire, which they had ſuſtained. (3.) The third means is, by *Aſſimilation*; when a hard Body aſſimilates a ſoft one contiguous to it.

Inſtances of Induration.

2. The Examples of *Induration* are many; as the Generation of Stones within the Earth; which, at firſt, are but rude Matter, or Clay: and ſo *Minerals*; which were originally Juices, concrete and harden [m]. We have other *Inſtances* in the making of Brick, Tile, and Glaſs; in the Exudations of Cryſtal, and Rock-Diamonds, which harden with Time [n]; the Induration of Amber, which, at firſt is a ſoft Subſtance [o], *&c.*

Trials recommended for Induration. (1.) *By direct Cold.*

3. As to *Indurations by Cold*, there are few Trials of it; for we have no intenſe Cold, here on the Surface of the Earth, ſo near the Sun. The likelieſt Trials are thoſe by means of Snow and Ice: for theſe Bodies, eſpecially when their Cold is actuated by *Nitre* or *Salt*, will ſoon turn Water into Ice; and may, perhaps, turn Wood, or ſtiff Clay, to Stone, in a longer time [p]. Let therefore, a Piece of Wood, or tough Clay, be laid in a Conſervatory of Snow, or Ice, with the Addition of ſome Quantity of *Nitre*; and let it lie for a Month, or longer [q].

4. An-

[l] A conſiderable part of *practical Philoſophy* depends upon the right underſtanding of the Ways of incorporating and mixing of Bodies. *Pharmacy*, in particular, has a great Dependance upon it: ſo have Chemiſtry, and many other Arts; eſpecially where Cements are concerned. But ſcarce any conſiderable Diſcoveries can be made in this Affair, without particular Sets of Experiments; whereby Bodies may be ranged into Claſſes, according to the Congruity, or Incongruity they have to each other; with regard to Incorporation, Mixture, and Union. And ſomething of this kind is begun by Monſ. *Geoffroy*, in the *French Memoirs*; and Dr. *Stahl*, in his *Specimen Beccherianum*, &c. Sir *Iſaac Newton* likewiſe, delivers ſome uſeful Hints to this purpoſe; both in his *Opticks*, and *Principia*.

[m] See Mr. *Boyle*'s *Treatiſe of the Origin and Virtues of Gems*; where this Point appears illuſtrated, and proved by a variety of *Inſtances*.

[n] See Mr. *Boyle*, in the Piece juſt mentioned.

[o] See various *Inſtances* in Confirmation hereof, in the *Philoſophical Tranſactions*.

[p] Are there any direct Inſtances of ſuch a Converſion? If there are, they ſhould be diligently collected, as *capital Things* that lead far into the Regions of Nature; and tend to enlarge the Power of Art. See Mr. *Boyle*'s *Hiſtory of Cold*; the *Philoſophical Tranſactions*; and the *French Memoirs*.

[q] See Mr. *Boyle*'s *Hiſtory of Cold*; and his *Memoirs for a general Hiſtory of the Air*.

(2.) *By metallic Waters.*

4. Another Trial may be made by means of *metallic Waters*; which have a *virtual Cold*. Put therefore, Wood, or Clay, into *Smithy-Water*; or other metallic Waters; to ſee whether the Matter will harden, in ſome reaſonable time. But this, I mean, of ſuch metallic Waters as are made by waſhing, or quenching; and not the *Aquæ Fortes*, made by Diſſolution: for theſe latter are too corroſive to conſolidate [r].

(3.) *By natural Springs, and other Waters.*

5. There are ſome natural *Spring-waters*, that will *petrefy Wood* [s]; ſo that in one Piece of Wood, the Part that was above the Water, ſhall continue Wood; and that Part under the Water, be turned into Stone [t]. Probably, ſuch petrefying Waters are ſome metallic Mixture; but a more particular Enquiry ſhould be made into them. 'Tis certain, that an Egg was found at the Bottom of a Moat, where, having lain many Years, the Earth had ſomewhat overgrown it; and this Egg was come to the hardneſs of a Stone; had the Colours of the White and Yolk, perfect; and the Shell ſhining in ſmall Grains, like Sugar, or Alabaſter. Another certain, and tried Experiment there is, of *Induration by Cold*; *viz.* that even Metals are hardened by often heating, and quenching them in cold Water [v]: *for Cold always works moſt powerfully when Heat has preceded* [u].

Trials for Induration, *by Heat.*

5. *For Induration by Heat*; it muſt be conſidered, (1.) that Heat, by exhaling the moiſter Parts, either hardens the Body, as in Bricks, Tiles, *&c.* or (2.) if the Heat be more fierce, it makes the groſſer Part itſelf run and melt; as in making ordinary Glaſs; and the Vitrification of certain Earths and Metals. In the *former* Caſe, which is hardening, by baking, without melting; the Heat firſt indurates; then makes the Matter fragile; and laſtly, incinerates and calcines it. But to make an *Induration with Toughneſs*, and leſs Fragility, a middle way ſhould be taken. For Example; let the Bodies be boiled in Water for two or three Days; but then they muſt be ſuch as the Water will not enter; as Stone; and Metal: otherwiſe, long boiling will rather ſoften than indurate them; as has been tried in Eggs, *&c.* therefore *ſofter Bodies* may be put into Bottles; and the Bottles hung in boiling Water, with the Mouths open above the Water, that no Liquor may get in; for by this means the *virtual Heat* of the Water will enter, without

[r] This Experiment appears to be well deduced, and intended: but I do not recollect its being tried. Perhaps it had better be tried with ſoft Wood, than Clay; becauſe Clay, unleſs it be firſt baked or hardened, is apt to diſſolve in Water: and, I ſuſpect, the Conſolidation here intended, is rather by *Appoſition* than *Alteration*, or *Converſion*. See below, § 7.

[s] For Inſtances of this Fact ſee the *Philoſophical Tranſactions*.

[t] Is not this a proper Tranſmutation: or what was *Wood* before, in the Judgment of the Senſes, and all other Trials, now become *Stone*; in the like Judgment of the Senſes, and all other Trials? And is not the Alteration effected by ſimple Appoſition; or ſome *ſtony* or *petreſcent Matter* entring into the Pores of the Wood; without otherwiſe *changing the internal Form* or *Texture* of the proper Fibres of the Wood? 'Tis of conſiderable conſequence, to have a juſt, and clear Underſtanding in this Matter.

[v] See Mr. *Boyle* on *Colours*, in *Initio*.

[u] This may prove an excellent Rule, in many Caſes of Practice.

without making the Body aduſt, or fragile; whilſt the ſubſtance of the Water is excluded [w].

6. We made Trial with a Piece of *Free-ſtone*, and with *Pewter*; put into the Water at large. The *Free-ſtone*, we found, received ſome Water; for it was ſofter, and eaſier to ſcrape than a Piece of the ſame Stone kept dry: but the *Pewter*, into which no Water could enter, became more white, (like to Silver) and leſs flexible, by much. *On Stone, and Pewter.*

7. There were alſo put into an earthen Bottle, placed as before, a *Pellet of Clay*, a *Piece of Cheeſe*, a *Piece of Chalk*, and a *Piece of Free-ſtone*. The *Clay* came out almoſt as hard as Stone; the *Cheeſe* likewiſe very hard, and not well to be cut; and the *Chalk*, and *Free-ſtone*, much harder than they were. The Colour of the *Clay* inclined not to the Colour of *Brick*; but, rather, to White; as in ordinary Drying by the Sun. Theſe Experiments were made by boiling upon a ſtrong Fire, and ſupplying the Water, as it conſumed, with other hot Water; but the boiling was continued *for twelve Hours only*: and, probably, the Effect would have been more conſiderable, had the Operation laſted two or three Days [x]. *On Clay, Cheeſe, and Chalk.*

8. As for *Aſſimilation*; of which there is ſome degree, even in Bodies inanimate; we ſee Examples of it in ſome *Clay Grounds*, where Pebbles are often found in a Lump together, with a Cruſt of Cement, or Stone, between them, as hard as the Pebbles themſelves: and it were proper to try, by putting *Pebble-Stones into Clay*, whether, in time, the Clay would not become harder than part of the ſame Lump, in which no Pebbles were ſet. We ſee in Ruins of old Walls, the Mortar will become as hard as the Brick: We ſee alſo, that the inſides of Wine-Veſſels gather a Cruſt of Tartar, harder than the Wood itſelf: and Scales likewiſe grow to the Teeth, harder than the Teeth themſelves [y]. But *Induration by Aſſimilation*, principally appears in the Bodies of Trees, and living Creatures: for no Nouriſhment that the Tree, or Animal, receives, is ſo hard as Wood, Bone, or Horn, *&c.* but is thus indurated by Aſſimilation [z].

IN-

[w] This Operation is what the Chemiſts call a *Bath-heat*, or working in *Balneo Mariæ*: which, tho an obvious and common Contrivance, does not appear to have been yet employed to many conſiderable Purpoſes, where it might be highly uſeful; and that, in what is called *Natural* or *Experimental Philoſophy*, as well as direct *Chemiſtry*: particularly, in making out the *extenſive Hiſtory* of *Jellies*, *Mucilages*, and *Glews*; into which kind of Matter all animal Subſtances are reſolvable, and of which they were, *perhaps*, originally formed. At leaſt, this Enquiry appears of ſome Importance; and ſhould be extended to the *Vegetable Kingdom*; if not, alſo, to the *Mineral*: where, ſhould the common *Balneum* prove too weak, the *Digeſtor* may take place.

[x] Theſe Experiments, therefore, ſhould be farther proſecuted.

[y] In what reſpect is *Tartar* harder than *Wood*, and the *Scales* of the *Teeth* harder than the *Teeth*? is it in being more Brittle? or, is Glaſs properly ſaid to be harder than Wood? This may only depend upon the arbitrary Signification of Words; but 'tis proper to uſe a *philoſophical Language* in *philoſophical Subjects*. Mr. *Locke*, in his *Eſſay upon human Underſtanding*, has endeavoured to ſettle this Point.

[z] Here ſeems to be a Neceſſity, not only for exactneſs of Language, but alſo for farther *Enquiry*; becauſe, *poſſibly*, the component Particles of Fluids, may be Solids. See Mr. *Boyle*, on the *Origin of Forms*, *Fluidity*, and *Firmneſs*, &c. And let Trial be made, whether certain Solids, by reducing them to extremely fine Parts, will not put on the Appearance, and exhibit all the Phænomena, of Fluids.

INFECTION.

Infectious Diſeaſes claſſed. Some known Diſeaſes are infectious; and others not. The infectious are, (1.) ſuch as lie chiefly in the Spirits, and not ſo much in the Humours; and therefore paſs eaſily from Body to Body: as Peſtilences, Lippitudes, and the like. (2.) Such as taint the Breath, which paſſes manifeſtly from Man to Man; and not inviſibly, as the Spirits do: Diſtempers of this kind are Conſumptions of the Lungs, *&c.* (3.) Such as come out at the Skin, and taint the Air, or Bodies adjacent; eſpecially if they conſiſt in an unctuous Subſtance, not apt to diſſipate; as the Itch, and the Leproſy. (4.) Such as are ſeated merely in the Humours, and not in the Spirits, Breath, or Exhalations: whence they never infect but by Contact; and ſuch a Contact as comes within the *Epidermis*; *viz.* the Venereal Diſeaſe, the Bite of a mad Dog[a], *&c.* See the *Articles*, ODOURS, PLAGUE, and POISONS.

INFUSION.

The ways of making accurate Infuſions; viz.

(1.) *By ſhort continuance, and renewal of the Subject.*

1. The *Rule for the Infuſion of Bodies containing fine Spirits*, which eaſily diſſipate, is, that *a ſhort Continuance gets out the Spirit, but a longer confounds it*; as extracting alſo the earthy part, which debaſes the finer[b]. It is therefore an Error in Phyſicians, to reſt ſimply upon length of time, for increaſing the Virtues of Tinctures and Infuſions. But if you deſire a ſtrong Infuſion of Bodies that have fine Spirits; the Way is, not to allow longer time; *but to repeat the Infuſion oftener*. For Example; infuſe a Pugil of Violets in a Quart of Vinegar, for three quarters of an Hour; then take them out, and refreſh the Infuſion with a like Quantity of new Violets, ſeven times; and it will make the Vinegar ſo freſh and ſtrong of the Flower, as to continue perfect for a Year: and indeed it ſmells better of the Flower a good while after, than at firſt[c].

2. The

[a] There ſeems to be wanting, a ſtrict *inductive Enquiry* into the Buſineſs of Infection; to ſhew whether (1.) any Diſtempers are properly infectious; (2.) which thoſe Diſtempers are; and, (3.) the Means of guarding againſt them. Are the *Plague*, the *Small-Pox*, the *Itch*, *&c.* ſtrictly and properly catching; or, communicative from Perſon to Perſon, without immediate Contact? May there not be ſome general Cauſe, as particular Diſpoſitions of Air, *&c.* capable of giving the ſame Diſtemper to ſeveral People at once, or in ſequence? Perhaps theſe things have not been ſo thoroughly examined, as to perſuade a cautious Man to ſpeak definitively, and poſitively about Diſeaſes, on either ſide of the Queſtion. The late Writings upon the Subject of the *Plague* at *Marſeilles*, may deſerve to be conſulted upon this Occaſion; and compared with the former Writers upon contagious Diſeaſes. See alſo Mr. *Boyle*, and the *Philoſophical Tranſactions*: Tho we have greater Expectations from *new Sets of accurate Experiments*, directly calculated for diſcovering the *Cauſes of Diſeaſes*. But this Method of Enquiry, however fully deſcribed by our Author in his *Novum Organum*; and exemplified in his own particular Hiſtories, eſpecially in that of *Life and Death*; ſeems to be little practiſed.

[b] This is an admirable Rule, and deſerves the particular Attention of *Phyſicians*, *Chemiſts*, and *Apothecaries*.

[c] But how will it be with regard to *Colour*? Perhaps the Curious may find ſomething here they did not expect.

2. The ſame *Rule* is of ſingular Uſe in the Preparation of Medicines, and other Infuſions. Thus the Leaf of *Borrage* has an excellent Spirit, to repreſs Melancholy, Vapours, and cure Madneſs [d]; yet, if infuſed long, it yields only a *raw Subſtance*, of no Virtue: but, perhaps, if the *Borrage* remain a little in new Wine, or Beer while it works, before it is tunned, and be often changed for freſh; it will make a ſovereign Drink againſt Melancholy. Underſtand the like of Orange-Flowers [e]. *The ſame Rule applicable in* Medicine.

3. *Rhubarb* contains Parts, of contrary Operations; *viz.* ſome that purge, and others that bind the Body: the firſt lie looſer, and the latter deeper in the Root; ſo that if *Rhubarb* be infuſed for an Hour, and well ſqueezed, it will purge more, and, after the Operation, bind the Body leſs, than if it ſtood for twenty-four Hours [f]: and, I conceive likewiſe, that by adding freſh *Rhubarb* ſeveral times, at ſmall Intervals, ſtill taking away the former, it may be made as ſtrongly purgative as Scammony [g]. *And it is no ſmall Secret in Phyſick, to make Rhubarb, and other kindly Medicines, purge as powerfully as thoſe that are not without ſome Malignity* [h]. *Particularly in the preparing the Tincture of Rhubarb.*

4. *The Virtue of purgative Medicines generally conſiſts in a fine Spirit*; for they loſe greatly of their Efficacy by boiling. It is therefore of good Uſe in Phyſick, *to retain the purging Virtue, yet take away the unpleaſant Taſte of Purgatives*; which, perhaps, may be done by *this Courſe of Infuſions*, quick repeated: for, it is probable, that the horrid and odious Taſte of theſe Medicines, proceeds from their groſſer Parts. *That the Virtues of Purgatives reſide in their Spirit.*

5. *Generally, the working by Infuſions, is groſs and blind*; unleſs it be known, which of the ſeveral Parts of the Body will ſooneſt come out; and which more ſlowly: and ſo, by ſuiting the time, to take and leave the Quality deſired [i]. To find this there are *two* Ways: the *one* is, to try what a long, and what a ſhort ſtay will effect; the *other*, to try ſeveral Infuſions of the ſame Body, ſucceſſively. For example; take *Orange-Peel*, *Roſemary*, or *Cinnamon*, and let them infuſe half an Hour in *Water*; then take them out, and infuſe them again in other Water; and ſo the third time: and you will find the ſeveral Liquors different, not only in Strength and Weakneſs; but alſo in Taſte or Odour: for, poſſibly, the firſt Wa-

[d] Is this found to anſwer, upon Experience?

[e] Here is a great and gainful Secret intimated: for by this Means any kind of Flavour may at pleaſure be given to Wines; ſo as, *even in Countries that have no Vines*, to imitate and exceed the *Colours*, *Flavours*, and *Richneſs* of any *natural Wine* of foreign Growth. Thoſe who pleaſe, may eaſily try the Experiment, with the freſh and green Leaves of *Baulm*; which give a Flavour, in ſome Judgments, approaching to that of the genuine *Frontignac*. See the *Article* SUGAR.

[f] Let this be tried; for the Thing may well deſerve it.

[g] This alſo deſerves to be tried to the full.

[h] This is more than a bare Conjecture; and may, poſſibly, be a Direction, even to thoſe, who have wholly applied to *Phyſick* and *Pharmacy*. Let the common *Diſpenſatory* Catharticks be examined by this *Rule*.

[i] Here ſeems to be an excellent Lecture for *Phyſicians*, *Apothecaries*, and *Chemiſts*; tending to ſhew us, what conſiderable Diſcoveries may be made in theſe Arts, by *proper Experiments*, and a *cloſe Attention to Nature*.

ter will have more of the Scent; and the ſecond more of the Taſte [k], &c.

Infuſions in Air, ſimilar to thoſe in Water.

6. *Infuſions in Air*, or ODOURS [l], *have the ſame Diverſities with Infuſions in Water*; as *ſeveral Odours* iſſue at ſeveral times from one *Flower*. For Example; Violets, Woodbines, Strawberries, &c. yield a pleaſing Scent, at firſt, whilſt they are freſh; but ſoon after one that is ungrateful, and differing from the former: which, may proceed from the groſſer Spirit coming out the lateſt [m].

How to diſcharge the Spirits of Bodies in ſome Caſes.

7. As we may deſire to extract the *fineſt Spirits* in ſome Caſes; ſo we may deſire to diſcharge them as hurtful in others. Thus *Wine* burnt, is leſs inflammatory than unburnt; by reaſon that the *finer Spirit*, is evaporated in the Operation: whence burnt-Wine becomes more proper in Fevers. *Opium* loſes its poiſonous quality, by being diſſolved with Brandy, and exhaled. *Sena* loſes of its Windineſs by boiling: and generally ſubtile Spirits are taken off by Evaporation. And in making Infuſions of Things, that have too high a Spirit; it were better to pour off the firſt Tincture, after a little time, and uſe the latter [n].

INSECTS.

Advantages of the Enquiry into the Nature of Vivification.

1. The *Nature of Vivification* is well worth the Enquiry: and as the Nature of Things is commonly perceived better in ſmall, than in great; and in imperfect, than in perfect, and in parts than in wholes; ſo the *Nature of Vivification* is beſt ſought in Creatures bred of Putrefaction [o]. The Advantages of this Enquiry are conſiderable, and tend (1.) to diſcloſe the Origin of Vivification; (2.) the Origin of Figuration; (3.) many Things in the Nature of perfect Creatures, which here lie more ſecret: and (4.) to transfer, in the way of Operation, ſome Obſervations on Inſects, to produce Effects upon perfect Creatures. The word *Inſect*, indeed, does not ſuit the Subject:

[k] There are *great Secrets* couched here; which Men muſt remain ignorant of, if they will not go upon *Experiments*.

[l] Obſerve the Expreſſion, *Infuſions in Air, or Odours*: for are not Odours made by the ſubtile Effluvia of the odoriferous Body, impregnating the Air, as a general *Menſtruum*; in much the ſame manner, as *Water* is impregnated by the ſubtile Parts of *tinging Bodies*, in fine Tinctures, or Infuſions? And indeed, is not the whole Atmoſphere, one vaſt Ocean of Air, impregnated with Millions of different kinds of Particles, ſo as to be, ſtrictly and properly, an univerſal *Solvent* or *Menſtruum*? Mr. *Boyle*, Dr. *Hook*, &c. have, perhaps, ſhewn this to be no Philoſophical Fiction.

[m] See this Doctrine purſued in *Boerhaave*'s Chemiſtry, under the *Proceſſes* upon *Vegetables*.

[n] The Enquiry here begun, ſo much imports the Improvement of *Medicine* and *Pharmacy*, that 'tis great Pity it ſhould not be continued, by a Collection of *capital Inſtances*, and Deductions; that, at length, we might have ſome tolerable certainty in theſe Arts, which, at preſent, lye almoſt uncultivated, with regard to uſeful Purpoſes, and ſolid Advantages. The *Pharmacopœia of the Royal College of Phyſicians* at *Edinburgh*, ſeems to have ſet a noble Example in this way.

[o] It has not perhaps been hitherto ſatisfactorily ſhewn, that any Creature is directly bred from Putrefaction; without the Interpoſition of *Eggs* or *Animalcula*. What are the fitteſt Experiments, or *crucial Inſtances*, to determine this Point?

Subject: but we uſe it, for Brevity, to denote *only Creatures bred of Putrefaction.*

2. *Inſects* are bred out of ſeveral Matters [p]; ſome out of *Mud* or *Dung*; as *Earth-worms*, *Eels*, *Snakes*, &c. both being Putrefactions: for Water putrefies in Mud, as not able to preſerve itſelf: and all Excrements are the refuſe and putrefactions of Nouriſhment [q]. Some breed in Wood, both growing and cut down; and at certain Seaſons. *Millepedes* or *Woodlice*, which roll themſelves into Balls, are bred chiefly under Logs of Timber, but not in the Timber; and they are ſaid to be found alſo in Gardens, where no Logs are. But it ſhou'd ſeem that their Generation requires a ſhelter, both from Sun, and Rain, or Dew; as Timber is: and *therefore they are not venomous* [r]; but held by Phyſicians to purify the Blood. *Inſtances of the breeding of Inſects, viz.* Woodlice.

3. 'Tis obſerved alſo, that *Bugs* are found in the Chinks and Crevices of Bed-ſteads. Some Vermin breed in the Hair of Animals: as Lice and Ticks; which riſe from the Sweat kept cloſe, and ſomewhat dry'd by the Hair [s]. The Excrements of living Creatures, not only breed Inſects, when they are voided, but alſo whilſt in the Body; as Worms, whereto Children are ſubject, breed chiefly in the Guts [t]. And in many peſtilential Diſeaſes, *Worms* are found in the upper parts of the Body, where Excrements are not; but only putrefied Humours. Bugs. Worms.

4. *Fleas* breed principally in Straw, or Mats, where there has been a little Moiſture, or the Chamber and Bed-ſtraw been kept cloſe, and not air'd [u]. 'Tis ſaid they are kill'd by ſtrewing of Wormwood in the Room [v]. And indeed bitter Things are apt rather to kill, than engender Putrefaction; as Things fat or ſweet, are apteſt to putrefy. Fleas.

5. There is a *Worm* that breeds in Meal, like a large white Maggot; which is given as a dainty to Nightingales. The *Moth* breeds upon Cloth, and Woollen, eſpecially if laid up damp and wet: it delights *Worms in Meal.* *Moths, and Wevils.*

[p] It might be ſafer, to ſay that *Inſects breed in*, rather than that *they are bred out of ſeveral Matters*; which ſeems preſuming too much upon a Knowledge of the Cauſe, before it is certainly found: whereas the buſineſs is to expreſs the Phænomena, ſo as to leave the Enquiry free and open; till the *Cauſe* can be fairly diſcovered by future *Experiments*, or a proper *Induction*.

[q] The Buſineſs of *Putrefaction*, in different Subjects, has by no means been well proſecuted by particular *Enquiries*, *Inſtances* and *Experiments*; which, properly purſued, might lay open a very important Scene, and give us more Light into the ſecret Works and Operations of Nature, than could be expected from ſome ſeemingly more honourable and grand Enquiries. See the *Notes* upon the *Article* GENERATION.

[r] What are the *Premiſes* of this *Conſequence*? It ſeems to intimate, that the *Venom in Animals*, proceeds from their being expoſed to the *Sun*, *Rain*, and *Dew*. Let the Fact be farther examined.

[s] If this be underſtood of the Matter, wherein they are bred, and whereby they are nouriſhed and increaſed in Bulk, it may, perhaps, be allow'd without begging the Queſtion, as 'tis called; or preſuming too much upon the Iſſue of the Enquiry.

[t] See M. *Andry* on the Subject of *Worms*, and the *Philoſophical Tranſactions*.

[u] For the Generation and Formation of Fleas, ſee a *Paper* in the *Philoſophical Tranſactions*, N° 249. See alſo Dr. *Hook*'s *Micrographia*, and Dr. *Power*'s *Experiments*.

[v] The good Houſewives have here found a *Cure*, without directly knowing the *Cauſe*; viz. frequent waſhing the Room, and Cleanlineſs.

lights to be about the Flame of a Candle. There is a *Worm* call'd a *Wevil*, bred under Ground, that feeds upon Roots; as Parsnips, Carrots, *&c.*

Water Insects and the Gad-fly.

6. Some *Insects* breed in standing Waters, especially if shaded; as the *Water-Spider with six Legs*. The Gad-fly breeds in somewhat on the top of the Water, and harbours chiefly about Ponds.

The Worm in Wine-Lees, and Snow.

7. There is a *Worm* bred in decay'd *Wine-Lees*; that afterwards turns to a *Gnat* [w]. It has been anciently observed, that a Worm breeds in old Snow; and is of a reddish Colour, dull of Motion, and dies soon after it leaves the Snow: which shou'd shew that *Snow has a secret Warmth*; otherwise it could hardly vivify. And the reason of the Worm's death, may be the sudden exhaling of that little stock of Spirit, as soon as it comes out of the Cold, which had shut it in [x]. For as *Butter-flies*, which were benummed with Cold, quicken with Heat; so Spirits may exhale with Heat, which were preserved by Cold.

A Creature bred in the Fire of a Furnace.

8. 'Tis *affirmed* both upon ancient and modern Observation, that in the Smelting-Furnaces for Copper and Brass, where *Chalcitis* [y] is often thrown in, to mend the working; there suddenly rises a *Fly*, which sometimes moves as if it took hold on the Walls of the Furnace; sometimes is seen moving in the Fire below; and dies as soon as it is out of the Furnace. This *Instance* deserves to be weigh'd [z]; as shewing that a violent Heat of Fire, as well as the gentle Heat of Animals will vivify, if it have Matter proportionable. The great AXIOM [a] of *Vivification*, is, (1.) that *there must be Heat to dilate the Spirit of the Body*; (2.) *an active Spirit to be dilated*; (3.) a *viscous or tenacious Matter to hold in the Spirit*; and (4.) *this Matter must be put forth and figured*. Now a *Spirit* dilated by so strong a Fire as that of a Furnace, presently congeals, as soon as the Furnace begins to cool. And possibly this Action is promoted by the *Chalcitis*, which has a Spirit that will shoot

The Axiom of Vivification.

[w] To the curious in *Experiments, upon Putrefaction and Vivification*, the Subject of *Wine-Lees* deserves to be particularly recommended; as affording very extraordinary Phænomena. For Instance, when these Lees are pressed hard and dry, and suffer'd to heat, by standing open, or uncloset; they seem to turn entirely into Millions of *Animalcula*, that swarm and cling together as it were in one Lump; much thicker and closer than the Mites in rotten Cheese. Besides this, there are many more Particulars worthy of Attention, in the same Subject, with regard to the change of *Colour, Odour, Taste, uncommon Stench, communicative Power*, &c. For an Introduction to this *particular Enquiry*, see an uncommon manner of *treating Wine-Lees*, in the *Essay* lately published upon the business of *Distillation, or the best Methods of producing, rectifying, and compounding inflammable Spirits*, &c.

[x] Has the Fact, as to the Existence of a *Worm in Snow*, been verified?

[y] What is strictly and properly meant by *Chalcitis*, seems but little understood. 'Tis a *Mineral, sui generis*, and found in the Copper Mines of *Germany, Sweden*, &c. See *Agricola*, and the later *Metallurgical Writers*.

[z] Let the *Fact* be first rigorously enquired into, as it highly deserves; for the Consequences are of great importance, *if the Fact be true*.

[a] Observe here an *Instance* of the AXIOMS, design'd for the sixth Part of the INSTAURATION; after they had been verified to the utmost: but all the *Author* could possibly do, for want of farther Experiments, and capital Instances in the Business *of Induction*, was only to make some first Attempts, to shew the way of forming these IMPORTANT AXIOMS.

ſhoot and germinate, as we ſee in chemical Trials. In ſhort, moſt Things putrefied bring forth Inſects of different kinds [b].

9. *Inſects* have been obſerved, but not with Diligence, to feed little: for *Graſs-hoppers* eat up the green of whole Countries; *Silk-worms* devour Leaves faſt; and *Ants* make great Proviſion. 'Tis true, Creatures that ſleep, and reſt much, eat little; as *Dormice*, *Bats*, &c. which are without Blood [c]: perhaps becauſe the Juice of their Bodies is almoſt one and the ſame [d]. Some of them, indeed, have a *Diaphragm*, and an *Inteſtine*: and they have all Skins; which in moſt of the *Inſects* are often caſt. *Obſervations upon the feeding of Inſects.*

10. They are not generally long liv'd; yet Bees have been known to live ſeven Years: and *Snakes* are thought to live many Years; perhaps from caſting their Skins. *Eels* will live and grow a very long time: and thoſe Creatures that change from *Worms* to *Flies* in the Summer, and from *Flies* to *Worms* in the Winter, have been kept in Boxes four Years. Yet there are certain *Flies* call'd *Ephemeræ*, that live but a day. The CAUSE may be their want of Spirits; or, perhaps, the abſence of the Sun: for if they were houſed, or kept cloſe, they might live longer. Many Inſects, being brought to the Sun, or Fire, eaſily revive, tho they ſeem'd dead; and this by reaſon of the diffuſion of the vital Spirit, and the eaſy dilatation of it by a little Heat. Some Inſects ſtir a good while after their Heads are off, or after being cut in pieces; perhaps becauſe their vital Spirits are more diffuſed thro' all the Parts, and leſs confin'd to Organs, than in perfect Creatures [e]. *Their Time of Living.* *Their ſtirring after Death.*

11. *Inſects have voluntary Motion*, and *therefore Imagination* [f]. As to what the Ancients have ſaid of their *Motion being indeterminate*, and their *Imagination indefinite*; this was negligently obſerved for *Ants* go ſtrait forwards to their *Hills*; and *Bees* know the way from a flowry Heath, two or three Miles off, to their own *Hives*. Perhaps, indeed, *Gnats* and *Flies* have their *Imagination* more mutable and giddy; as ſmall Birds likewiſe have. Some of the Ancients ſay, theſe Creatures have only the *ſenſe of Feeling*: which is manifeſtly falſe; for if they go ſtrait to a place, they muſt needs have Sight. Beſides, they delight more in one Flower, or Herb, than in another; and therefore have Taſte. And *Bees* are call'd with the ſound of Braſs; and therefore have Hearing: which ſhews likewiſe, that tho *Whether Inſects think.*

[b] To purſue the *Enquiry*, (1.) all the kinds of Putrefaction ſhou'd be enumerated, and claſſed, with regard to the different Creatures they appear to produce. (2.) Accurate Experiments ſhould be made, to determine how far the Operation itſelf, and how far the Matter, or Seat of the Operation, contributes to the Production. (3.) Whether any Rudiments of *Inſects*, *Eggs*, or *Animalcula*, are naturally contained within ſuch Putrefactive Subſtances; and are only extricated, excluded, or vivified in, or by the Operation? And (4.) Laſtly, Whether there be any ſuch thing as *ſpontaneous Generation*? with a ſtrict Examination of all the *capital Inſtances* that appear to ſhew it. The ſtrict inductive *Method of proſecuting all ſuch Enquiries* is fully laid down in the *Novum Organum*, Part II.

[c] Are *Dormice*, *Bats*, *Swallows*, &c. which ſleep all the Winter, Creatures without Blood? I ſuppoſe the Author means *Blood* with regard to *redneſs* of Colour: but is even this ſtrictly true?

[d] See the *Article* SLEEP.

[e] See the Obſervations upon *Tortoiſes*, *Vipers*, and other Creatures of this kind, in Mr. *Boyle*, the *Philoſophical Tranſactions*, &c. See alſo the *Article* LIFE.

[f] This compared with the Doctrine of Mr. *Locke*, in his Eſſay on *Human Underſtanding*, concerning the Poſſibility of *Matter's Thinking*, may poſſibly ſolve his *Difficulty*.

tho their Spirit be diffuſed, yet the Seat of their Senſes is in the Head [h]. See the *Articles* ANIMALS, CATERPILLARS, GENERATION, LIFE, and PUTREFACTION.

L.

LASSITUDE.

The Cauſe and Remedy of Laſſitude.

Laſſitude is remedied by *bathing*, or anointing with Oil and warm Water: for all Laſſitude is a kind of Contuſion of the Parts [i]; but bathing and anointing, relax and ſupple. And a mixture of *Oil* and *Water*, is better for this purpoſe than either Oil or Water alone; becauſe Water inſinuates better into the Pores, and Oil, after entry, ſoftens better [k]. 'Tis found alſo, that the taking of Tobacco relieves in *Laſſitude*. The Reaſon whereof may be, that by chearing or comforting of the Spirits, it opens the Parts compreſſed, or bruiſed; but chiefly, becauſe it refreſhes the Spirits by its opiate Virtue; and ſo diſcharges wearineſs, as Sleep does.

Why going up Hill tires the Knees.

2. In going up Hill, the *Knees* will be moſt weary; in going down Hill, the *Thighs*: for in lifting the Feet, when one goes up the Hill, the weight of the Body bears moſt upon the *Knees*; and in going down, upon the *Thighs* [l].

LEAPING.

The Uſe of Weights, and ſwinging the Arms in LEAPING.

A Man leaps better with Weights in his Hands, than without: becauſe the Weight, if proportionable, ſtrengthens the Sinews by contracting them [m]. But otherwiſe, where no Contraction is neceſſary, Weight hinders; whence in *Horſe-races*, Men are curious to examine, whether one Horſe carries ever ſo little Weight more than another. In Leaping with Weights, the Arms are firſt thrown backwards, then forwards, with ſo much the greater Force; for the Hands are ſwung backward before the Leaper riſes: and in throwing a Stone, the Arm is firſt caſt backward, in order to make the greater ſwing. *Quære*, whether the contrary Motion of the Spirits, immediately before the Motion intended, does not cauſe the Spirits, as it were to break

[h] And this, perhaps, may be the Caſe in all Animals; but the Thing ſhould be verified by *Experiment*, and *Crucial Inſtances*.

[i] It may deſerve to be enquired, how the Cold Bath, as well as the Warm, ſhould preſently take off wearineſs.

[k] It is a remarkable Experiment, which ſhews that *Water* will enter where *Air* cannot; as particularly thro' the Pores of a Bladder, or perhaps any other Body, that is glutinous, mucilaginous, or fizy.

[l] And hence, perhaps, the Reaſon why ſome People can go up Hill better in proportion than down; *viz.* according to the difference betwixt the Strength or Ability of their *Hams* and *Knees*. And this may likewiſe be the Caſe with Horſes: ſome whereof will run excellently upon a flat Courſe, but fail upon an uneven one.

[m] I ſuppoſe the Author means by increaſing their Elaſticity; as when a muſical Inſtrument is ſtretched, it will recoil with greater Force.

break out with more Force [n]? as the Breath drawn and kept in, comes out more forcibly [o].

LIFE.

1. Some Creatures move a good while after their Heads are off, as *Birds*; ſome a very little time, as *Men* and all *Beaſts*; ſome move tho cut into ſeveral pieces; as *Snakes*, *Eels*, *Worms*, *Flies*, &c. Firſt therefore, the *immediate* CAUSE *of Death, is the Reſolution, or Extinction of the Spirits:* the Deſtruction or Corruption of the Organs, being only the mediate Cauſe. But ſome Organs are ſo abſolutely neceſſary, that the extinction of the Spirits ſpeedily follows upon their Deſtruction; tho there is ſome ſmall Interval. *'Tis credibly reported*, that a ſacrificed Beaſt has lived after the Heart was taken out; and that the Head of a Pig being open'd, and the Brain put into the Palm of a Man's Hand, without breaking any part of it, or ſeparating it from the ſpinal Marrow, the Pig remain'd in all appearance dead and motionleſs; yet when after a ſmall time the Brain was replaced, and the Scull cloſed, the Pig ſoon after walked. And an *Eye* upon the Act of Revenge has ſtarted out, ſo as to hang a conſiderable diſtance by the optic Nerve; and during that time the Eye was without any power of Sight: yet after, being replaced, the Sight was recovered [p].

Of Motion *after the inſtant of Death, with a View to its* CAUSE.

2. Now the *Spirits are chiefly lodged in the Head, and Cells of the Brain*, which in Men and Beaſts is large; and therefore when the Head is off, the Body moves little or nothing. But *Birds* have ſmall Heads; whence the Spirits are a little more diſperſed in the Nerves, whereby Motion remains in them a little longer [q]; inſomuch that a Roman *Emperor*, to ſhew the certainty of his Hand, is related to have ſhot a forked Arrow at an *Oſtrich*, as ſhe ran ſwiftly along the Stage, and ſtruck off her Head; yet ſhe continued running a little way with her Head off. As for *Worms*, *Flies*, and *Eels*, the Spirits

The vital Spirits of ſome Creatures ſeated chiefly in the Head.

[n] For Inſtance, in the Caſe of a Racer, who has carried Weights in his Pocket, a little before he is to run: for ſuch Practices ſeem to have conſiderable Effects, more than can well be attributed to the bare loading of the Body; and then laying the Load aſide. And *Query*, what length of Time theſe Weights are beſt carried before the Race; whether ſome Hours, or Days?

[o] The *Doctrine of Exerciſes* ſeems reducible to eaſy *mechanical Rules*. Thus, the Weights held in the Hands in Leaping, ſtretch the Arms, and cauſe them to move, or ſwing like Pendulums, or in a kind of Semicircle, whereby the Body is carried ſomewhat higher, and farther, before it comes to the Ground. Let *Borelli* be conſulted upon the Subject.

[p] There are many *Inſtances* of this kind related by Authors, and handed down by Tradition: certainly they ſhould not be raſhly rejected, nor diſcountenanced by Ridicule; but ſtrictly enquired into, by thoſe who deſire to diſcover the Works of Nature, and improve Philoſophy. For who knows the Lengths whereto Nature may go in all Caſes? *Credulity*, however, is to be as ſtrictly guarded againſt; in making a proper Collection of theſe *capital Inſtances:* which if extant, in tolerable Perfection, many *great Effects*, with regard to *Life and Death*, might poſſibly be wrought from the *Axioms* they would indicate. See the Author's *Hiſtory of Life and Death.*

[q] The *Reader*, perhaps, cannot too cloſely attend to theſe Beginnings, or firſt Attempts of the *Author*, for *interpreting Nature*. Such *Attempts* are numerous throughout all the Work: and the way of improving them is ſufficiently laid open in the *Novum Organum*.

Spirits are diffuſed almoſt all over them: whence theſe Creatures move, tho cut into ſeveral pieces[r]. See the *Articles* INSECTS and MOTION.

The means of prolonging Life.

3. It conduces to long Life, and the more placid Motion of the Spirits, which thence prey leſs upon the Juices of the Body; (1.) that Mens Actions be free and voluntary, ſo as nothing may be done againſt the Grain; (2.) that their Actions be full of Regulation, and Commands within themſelves: for then the Victory and performing of the Command, gives a good Diſpoſition to the Spirits; eſpecially if there be a Progreſſion from degree to degree: for then the Senſe of Victory is the greater[s]. An Example of the *former*, we have in a *Country Life*; and of the *latter* in Monks, Philoſophers, and ſuch as continually enjoin themſelves Tasks[t].

LIGHT.

The Reſult of many Experiments upon the ſhining of rotten Wood.

1. I have with ſome Diligence purſued the *Experiment of Wood ſhining in the dark*: the rather, becauſe of all Things that give Light here below, it is the moſt durable; yet has the leaſt apparent Motion. *Fire* and *Flame* are in continual Expence; *Sugar* ſhines only while it is ſcraped; and *Salt-water* while it is daſhing: *Glow-worms* ſhine only while they are alive, or a little after; only the Scales of *putrefied Fiſhes* ſeem to be of the ſame Nature with *ſhining Wood*: and indeed all *Putrefaction* is *attended with an internal Motion*; as well as Fire or Light[u].

2. The reſult of my Enquiry is this: (1.) That the ſhining is in ſome Pieces more bright, in others more dim; but the moſt bright of all does not equal the Light of the *Glow-worm*. (2.) The kinds of *Wood* that have been found to ſhine, are chiefly *Sallow*, *Willow*, *Aſh*, *and Hazle*; tho perhaps it may alſo hold of others. (3.) Both the Roots and Bodies of the Tree ſhine; but the Roots the better. (4.) The Colour of the ſhining part, by Day-light, is in ſome pieces White; in ſome, inclining to Red. (5.) The part that ſhines, is generally a little ſoft, and moiſt; but ſome was found to be firm and hard; ſo that it might be faſhion'd into a Croſs, or Beads[v], *&c.* But we muſt not expect an *Image*, or the like, in any thing Luminous; for even a Face in Iron, red hot, will not be ſeen; the Light confounding the ſmall Differences of Light and Dark, which ſhew the Figure[w]. (6.) The ſhining part being pared off, till we came to that which did not ſhine; within two Days the part contiguous alſo began to ſhine; being expoſed to the Dew: ſo that it ſhould ſeem the Putrefaction ſpreads. (7.) Other dead Wood of the like kind, being expoſed in the Air, ſhone not at the firſt; but after a Night's lying, it begun to ſhine. (8.) Other Wood

[r] Mr. *Boyle*, and ſome few others, have proſecuted this Enquiry: but it ſtill ſeems to require more Hands.

[s] Hence *Hope* is, perhaps juſtly, accounted a *wholeſome Paſſion*.

[t] See this Subject proſecuted in the Author's *Hiſtory of Life and Death*.

[u] This is a capital Obſervation.

[v] This might be a gainful Intimation in a *Catholick Country*.

[w] Here lies the Foundation of Painting, or what they call *Chiaro Obſcuro*, or *Light and Shadow*.

Wood, that ſhone at firſt, being laid dry in the Houſe, loſt its ſhining Faculty within five or ſix Days; and being expoſed again, recover'd it. (9.) Some ſhining Woods being laid in a dry Room, loſt their ſhining Property within a Week; but being laid in a Cellar, or dark Room, retain'd it. (10.) The boring of Holes in this kind of Wood, then laying it abroad, ſeems conducive to make it ſhine: *as all Solution of Continuity promotes Putrefaction* [x]. (11.) No Wood has been yet found to ſhine, that was cut down alive; but ſuch only, as was rotted both in the Stock, and Root, as it grew. (12.) Part of the Wood that ſhone, being ſteeped in Oil, retain'd the ſhining Virtue for a Fortnight. (13.) The like Succeſs, but in a much greater degree, attended ſome that was ſteeped in Water. (14.) How long the ſhining will continue, if the Wood be expoſed every Night, and taken in and ſprinkled with Water in the Day, is not yet tried. (15.) Trial was made of expoſing it in froſty Weather; which did not hurt it. (16.) The ſhining part being cut off from a great piece of a Root, till what was left ſhone no more; yet after two Nights, tho kept in a dry Room, it ſhone again [y]. See the *Article* VISION.

LIQUIFACTION.

The Cauſe of Liquifaction in Bodies.

1. Liquifaction is cauſed by *the Detention of the Spirits which play within the Body, and open it* [z]. Therefore ſuch Bodies as are, (1.) more turgid with *Spirit*; or, (2.) have their *Spirits* more cloſely impriſon'd; or, (3.) hold them more at eaſe, are *liquifiable:* for theſe *three* Diſpoſitions of Bodies keep in the Spirits. An Example of the *two firſt* Properties we have in *Metals*; and of the laſt, in *Sulphur*, *Pitch*, *Wax*, &c.

The Cauſe why Bodies are not liquifiable.

2. The *Indiſpoſition to liquify, proceeds from the eaſy Emiſſion of the Spirits, whereby the groſſer Parts contract*; and therefore, Bodies jejune in *Spirits*; or that willingly part with their Spirits, are not liquifiable; as *Wood*, *Clay*, *Free-Stone*, &c. Yet many of thoſe Bodies that will not melt at all, or elſe with difficulty, however grow ſoft; as *Iron* at the Forge: and a *Stick bathed in hot Aſhes, thereby becomes more flexible* [a].

Some Bodies liquifiable by Fire, others by Water.

3. Some Bodies liquify or diſſolve by Fire; as *Metals*, *Wax*, &c. and others diſſolve in Water; as *Salt*, *Sugar* [b], &c. The CAUSE of the former, is the *Dilatation of the Spirits by Heat:* and of the latter, *the opening of the tangible Parts*, which have an Appetite to receive Moiſture. Again, ſome Bodies diſſolve both in *Fire* and *Water*, as Gums [c]; *&c.* And theſe are

[x] This is a noble Intimation for the *Hiſtory of Putrefaction.*

[y] Theſe Experiments perhaps have rather been verified and repeated, than greatly improved and extended by the later Writers. See Mr. *Boyle*, Dr. *Power*, Dr. *Hook*, &c.

[z] This Doctrine of Spirits, will appear ſo ſtrange to many, that it can ſcarce be ſufficiently guarded; unleſs the Reader has himſelf been converſant with cloſe *Obſervations* and *Experiments.*

[a] On this *Experiment* ſtands that noble *Diſcovery of bending large Timbers*, for the Building of *Ships*, now commonly practiſed in all the *Yards.*

[b] *Salt* and *Sugar* alſo diſſolve by Fire, and run thin.

[c] Some *Gums* diſſolve in Water, and others not; of the former kind are *Gum Arabic*, *Gum Tragacanth*, &c. of the latter, *Galbanum*, *Storax*, &c.

ſuch, as have both Plenty of Spirit; and their tangible Parts indigent of Moiſture: the former promotes the Dilatation of the Spirits by the Fire; and the latter ſtimulates the Parts to receive the Liquor[d].

M.

MAGNETISM.

Leading Experiments upon the Magnet.

1. THE *Loadſtone* attracts the Powder of prepared Steel; ſuch as they uſe in Medicine[e]; and even calcined Steel, reduced to a fine black Powder: and this as ſtrongly, as it does the crude Filings of Iron: but for the artificial *Crocus Martis*, the Loadſtone attracts it faintly.

2. If the *Iron* be diſſolved in *Aqua fortis*, and ſome drops of the Solution be laid upon a flat Glaſs; the *Loadſtone* neither attracts the Solution itſelf, nor the Iron out of it.

3. The *Loadſtone* attracts its own Filings, as if they were *Filings of Iron*; and very little pieces of a *Loadſtone* attract one another, ſo as to become pendulous, and apparently united like a Hair or Needle.

4. If a *Loadſtone* be placed at ſuch a diſtance from *Iron*, as not to attract it, and an *Iron Cap* be placed between them; it will now attract it; tho the diſtance be the ſame: the Virtue of the *Magnet* being better diffuſed thro' *Iron*, than thro' the medium of the Air alone.

5. If a *Loadſtone* be plunged in *Aqua fortis*, and there ſuffered to remain for ſeveral Hours, it loſes no part of its Virtue.

6. The *Loadſtone* does not increaſe its Virtue, by being rubbed upon Cloth, as Amber does; or againſt another *Loadſtone:* nor by being heated at the Fire.

7. One *Loadſtone* has a much more attractive Virtue than another; and in proportion thereto, tranſmits its Virtue to *Iron* upon the touch: and this Virtue is not only a Virtue of *Verticity*, but alſo of *ſimple Attraction*; for if a piece of *Iron* be touch'd with a ſtrongly attractive Loadſtone; and another piece in like manner by a weaker; the Iron touch'd by the ſtronger *Loadſtone*, will attract a greater weight of Iron, than the piece will that was touch'd with the weaker.

8. The *Loadſtone* attracts *Iron* at an equal diſtance thro' *Air*, *Water*, *Wine* and *Oil*.

9. *Loadſtone*,

[d] The due Proſecution of this Enquiry, has a great regard to the improvement of *Metallurgy*, *Pharmacy*, and *Chemiſtry*. The generality of Philoſophers ſeem to have overlook'd it. But Dr. *Stahl* has many noble *Obſervations* and *Experiments*, that may add much Light to the Affair. See alſo Mr. *Boyle* upon *Fluidity* and *Firmneſs*, &c. It were proper in this Enquiry, to *claſs Bodies*, according as they are diſpoſed for *Fuſion*, or *Liquifaction*, by the Fire; as the Author has here begun: and by means of certain Tables, to ſhew at one View, the Bodies with their ſeveral *Menſtruums*. It is not eaſy to imagine of how great Service this Procedure wou'd be in *Chemiſtry*, and *practical Philoſophy*; and to what conſiderable Diſcoveries it might lead. Perhaps the want of a proper Solvent for the Stone in the Bladder, is owing to a neglect herein.

[e] Does the *Loadſtone* attract *Iron* prepared with *Sulphur*?

9. *Loadſtone, either whole or powdered,* put into *Aqua fortis,* does not diſſolve, in the leaſt, as Iron does; tho *Loadſtone* may otherwiſe ſeem a Body of the ſame Subſtance with Iron.

10. *Powder'd Loadſtone* neither attracts *touched* nor *untouched Iron*; yet the Powder is attracted by *touched* Iron, but not by *untouched:* ſo that *powder'd Loadſtone* ſeems, in ſome meaſure, to retain the paſſive, and loſe the active Virtue of the Stone.

11. If a *Needle,* when laid upon a Plane, prove ſomewhat too heavy for the *Loadſtone* to attract; yet the *ſame Needle* being laid upon the foot of an inverted drinking Glaſs, ſo as to hang over the Edges, on both Sides; the *ſame Loadſtone* will then attract it. Which Obſervation deſerves the rather to be related; becauſe ſomething of this kind might poſſibly give occaſion to the frivolous Story, that the *Diamond* obſtructed the Virtue of the *Magnet.* For if a *Needle* be laid upon a ſmall *Table-Diamond,* and the *Loadſtone* be held at a greater diſtance than its attractive Virtue reaches; yet the Needle will tremble: whilſt this trembling is not a ſuppreſſion of Motion, but Motion itſelf.

12. The *Loadſtone* attracts *touch'd Iron* more ſtrongly than *untouch'd,* in the proportion of three to one; or at three times the diſtance.

13. No *Iron,* or metallic Matter, is extracted from the Loadſtone by Fire; nor is there any viſible ſeparation made [f].

14. The *Loadſtone* diſſolves not in *Aqua regia,* any more than in *Aqua fortis.*

15. If a *Loadſtone* be detain'd in an ignited *Crucible,* but ſo as not to flame; it loſes much of its Weight, and more of its Virtue: ſo as ſcarce afterwards to attract *Iron.*

16. *Loadſtone* melts with difficulty, but ſomewhat changes its Figure, and grows red in the Fire, like *Iron.*

17. If a *Loadſtone* be burnt whole in the Fire, it retains its paſſive Virtue, ſo as to follow another Loadſtone; but almoſt loſes its active Virtue of attracting *Iron.*

18. A *Loadſtone* burnt in a *Crucible,* emits a Fume, tho it be ſcarce viſible; which ſomewhat blanches a Plate of *Copper,* laid over it, as Metals uſually do.

19. The *Loadſtone* in burning, paſſes thro' the *Crucible*; as appears by the ſhining of the Crucible when broke, both on the inſide and the out.

20. 'Tis univerſally agreed, that if a *Loadſtone* be ſo far burnt, as to yield a certain dull and ſulphureous Flame, it totally loſes its Virtue; ſo as never to recover it again, tho cool'd in the Poſition of *North* and *South:* which is a Thing that gives a magnetic Virtue to *Bricks*; and reſtores it in *Loadſtones* that have not been burnt to the utmoſt.

21. An Experiment was made of the *Loadſtone,* and a touched Needle, upon the top of St. *Paul*'s Church at *London*; which is one of the higheſt in

[f] Has the proper *Flux* been uſed for this purpoſe?

Europe, but the attractive Virtue was not found in the leaſt diminiſh'd, or any way alter'd by that Diſtance from the Ground [g].

MANNA.

The Origin of Manna.

The *Manna* of *Calabria* is collected in greateſt Plenty, and accounted the beſt: they gather it from the Leaf of the *Mulberry-tree*; but not ſuch as grow in the Valleys. And *Manna* falls upon the Leaves by Night; as other Dews do [h]. It ſhou'd ſeem, that before theſe Dews can come upon the Trees in the Valleys; they diſſipate, and do not hold out. The *Mulberry-leaf* alſo may have ſome coagulating Virtue, which inſpiſſates the Dew; for 'tis not found upon other Trees: and we may ſee by the Silk-worm, which feeds upon that Leaf, what a curious ſmooth Juice it has. The Leaves alſo, eſpecially thoſe of the black Mulberry, are ſomewhat briſtly; which may help to preſerve the Dew. It were proper to obſerve, with greater Diligence, the Dews that fall upon *Trees*, or *Herbs* growing upon Mountains; for perhaps many Dews fall, that ſpend themſelves before they come to the Valleys [i]. And I ſuppoſe, he who would gather the beſt *May*-Dew for Medicine, ſhould gather it from the *Hills* [k].

MATURATION.

The means of Ripening Liquors.

1. To *accelerate Maturation*, is a Capital Work in *Nature*. The *Maturation of Drinks* is wrought by collecting the Spirits together, whereby

[g] Theſe Experiments are not like thoſe we commonly meet with in Writers upon this Subject; but, in the peculiar way of the Author, directly levelled at finding the CAUSES *of Magnetiſm*. Millions of random Experiments may be made with the *Loadſtone*; which, however curious or ſurprizing, ſhall make but little to the Merits of the *Enquiry*: they are *leading Experiments, crucial Inſtances, larger Obſervations, Canons*, and *general Axioms*, that are wanting on this occaſion. And unleſs the Experimentor has a View to theſe, he may waſte much Time in *Magnetics* to very little purpoſe. But for the particular Method of conducting this *Enquiry*, 'tis proper, as upon all the like occaſions, to refer to the ſecond Part of the *Novum Organum*. See alſo Mr. *Boyle*, upon the Subject of *Magnetiſm*; Mr. *Whiſton*'s *Dipping-Needle*; the *Philoſophical Tranſactions*, &c.

[h] Poſſibly this may be a vulgar Error; or an Inſtance of *haſty Induction*. It ſhould rather ſeem, ſo far as the later Obſervations and Experiments reach, that *Manna* is an exudation in the Leaves of certain Trees; and no other than a *ſaccharine Juice*; wherewith many Trees abound: as particularly the *Birch*, the *Sycamore*, the *Maple*, &c. And cou'd not *Manna* be made from the *Tears* or *Tappings* of the Trees, whereon it is found? See the *Article* SUGAR.

[i] Theſe Obſervations upon Dews, have not been cloſely proſecuted; and, perhaps, there is ſome conſiderable Myſtery in them.

[k] The Foundation for the Rule ſeems to be this, that the *Atmoſphere* is more impregnated with groſs terreſtrial Effluvia, Smoke, *&c.* near the Surface of the Earth, than higher up: and accordingly the *pureſt Water* appears to be collected in high Places; at a conſiderable diſtance from large Towns. But how this may hold of Dew, is another Queſtion. To render Dew medicinal, perhaps it ſhould participate of the Plants it hangs on; where it may drink in part of their finer Particles. But Experiment alone can determine this. There is much *Curioſity*, and ſome *Utility*, in tracing the *Hiſtory of Manna*; thro' (1.) its firſt Preparation; (2.) Collection; (3.) Adulteration; (4.) proper Refinement, and exact *Imitation*; by means of the Materials of every Country. The *Hiſtory of Sugar* might give Light in this Affair.

by they more perfectly digeſt the groſſer Parts: and this is effected partly by the ſame means as *Clarification* [l]. But *extreme Clarification* ſpreads the Spirits ſo ſmooth, that they become dull; and render the Drink dead: which ought to have a little flowering. Whence all clear, *Amber Drink* is flat [m]. The degrees of Maturation in Drinks, are obſervable in *Muſt*, *Wine*, and *Vinegar*: In *Muſt*, the Spirits are not well collected together [n]; *Wine* has them well united; ſo that they make the Parts ſomewhat more oily [o]: whilſt *Vinegar* holds them collected more jejunely, and, in ſmaller quantity; the largeſt and fineſt Spirit thereof being exhaled [p]: for *Vinegar* is made by ſetting a Veſſel of *Wine* in the hot Sun; and therefore *Vinegar* will not burn; becauſe many of the finer Parts are exhaled [q].

The ways of recovering flat Liquors.

2. The refreſhing and quickening of palled or dead Drink, proceeds from enforcing the Motion of the Spirit: Thus we find, open Weather relaxes the Spirit, and makes it more lively in its Motion. We ſee alſo the *bottling* of *Beer* or *Ale*, while new, and full of Spirit, makes the Drink more quick and windy [r]. A Pan of Coals, likewiſe, does good in the Cellar, and makes the Drink work again [s]: nay, 'tis affirmed, that a brewing of new Beer, ſet by old Beer, makes it ferment again [t]. It were alſo proper to *ferment the Spirits by Mixtures*, that may excite and quicken them; as by putting into the Bottles, *Nitre*, *Chalk*, *Lime* [v], &c. We ſee *Cream* is matured, and

[l] See the *Article* CLARIFICATION.

[m] Could not this Effect be eaſily prevented? Or could not *Malt Liquors* be racked from their Lees, and fined, and treated as *Wines*? Some *Experiments* have been made with Succeſs in this way. And perhaps it is a vulgar Error to imagine, that Malt Liquors muſt needs lye upon their Lees, to preſerve their briskneſs. A skilful Operator may do ſomething conſiderable in this matter.

[n] In reality, perhaps, they are not formed: the vinous, or inflammable Spirits certainly are not extricated; ſo as to preſide, in the Form of inflammable Spirits.

[o] In *Wine*, the Operation of *Fermentation*, which perhaps conſiſts in thouſands of *Occurſions* and *Attritions* of the ſmall Particles among one another, forms part of the oily Matter, and Acid of the Subject, into *vinous*, or *inflammable Spirit*.

[p] There is a great Secret in *Acetification*; known perhaps but to very few: thoſe who have it, may, with Dr. *Stahl*, convert *perfectly rectified Spirit of Wine* into *Vinegar*; and produce ſtrong and noble Vinegar, from *exceedingly cheap Commodities*; in the ſpace of a very few days; even in the *Winter*. See the *Article* VINEGAR.

[q] Some of the finer Parts of the *Wine* will doubtleſs be evaporated: but the Queſtion is, whether the *inflammable Spirits* evaporate in the Operation; or are not really incorporated, loſt in their former Nature, and converted into a very different Thing? For cannot the *beſt Wine*, contained in a *cloſe Bottle*, be converted, *barely by Heat*, into *excellent Vinegar*?

[r] A careful diſtinction ſhould be obſerved, in this whole Enquiry, betwixt *inflammable Spirit*; and what may for clearneſs ſake, be called the *wild*, *crude*, or *gaſſy Spirit*; which chiefly ſhews itſelf whilſt Liquors are new; or before they have finiſhed their Courſe of *vinous Fermentation*.

[s] The *Germans* make excellent uſe of this Contrivance, in their *Wine Vaults*; and thus become a kind of *Creators* in the Affair of *Wines*.

[t] The Truth of this *Fact* can hardly be queſtion'd by thoſe who have been converſant in *Wine Vaults*. And conſiderable Secrets lie in the proper management of this *Natural Power*.

[v] The beſt Additions of this kind, are, perhaps, the common ones; *viz.* a little *Sugar*, or two or three *Raiſins*.

and made to riſe more ſpeedily, by the addition of cold Water; which ſeems to get down the *Whey* [v].

And preſerving them freſh.

3. It has been try'd, that burying well ſtopped Bottles of Drink, either a good depth in dry Earth, or at the bottom of a Well, within Water; but beſt of all by hanging them in a deep Well, ſomewhat above the Water, for a Fortnight, are excellent means of making Drink freſh and quick: for Cold does not exhale the Spirits at all, as Heat doth; but makes them vigorous, and active: whereby they perfectly incorporate the Parts of the Liquor [w].

The means of ripening Fruits.

4. The *Maturation of Fruits*, is effected, (1.) *by calling the Spirits of the Body outward*; and *ſo diffuſing or ſpreading them more eaſily*: and (2.) by *digeſting*, in ſome degree, *the groſſer Parts*: and this is procured, (1.) by *Heat*, (2.) *Motion*, (3.) *Attraction*; and (4.) a beginning *Putrefaction*, which is a kind of *Maturation* [x].

Experiments of Maturation tried by encloſure in Apples.

5. *Apples* were laid in, (1.) *Straw*; (2.) in *Hay*; (3.) in *Flower*; (4.) in *Chalk*; (5.) in *Lime*. (6.) Others were cover'd over with *Onions*; (7.) others with *Crabs*; (8.) ſome were cloſed up in *Wax*; another ſhut in a *Box*, &c. and (9.) one was hung up in Smoak [y]. After a Month's time, the *Apple enclos'd in Wax*, was as green, and freſh, as at the firſt putting of it in; the Kernels continuing white. *For all excluſion of open Air, which is ever predatory, maintains the Body in its firſt Freſhneſs and Moiſture* [z]: but the inconvenience was, that it taſted a little of the Wax; which, I ſuppoſe, wou'd not happen in a Pomgranate, or ſome ſuch thick-coated Fruit. The *Apple hung in Smoak*, grew, like an old mellow Apple, wrinkled, dry, ſoft, ſweet; and yellow within: for ſuch a degree of Heat, which neither *melts* nor *ſcorches*, *mellows* without burning. The *Smoak* alſo ſprinkles, as it were, the *Apple* with Soot; which promotes Maturation. So in drying of *Pears* and *Plumbs* by the Oven, and removing them often, as they begin to ſweat; there is a like Operation: but this is perform'd with a far more intenſe degree of Heat. The *Apples buried in the Lime* and *Aſhes*, were well maturated; as appeared both by their Yellowneſs and Sweetneſs. For that degree of Heat, which is in *Lime* and *Aſhes*, being a ſmothering Heat, is of all others the moſt proper for the purpoſe; as it neither liquifies nor dries: which is true *Maturation*. And the Taſte of the Apples was good; ſo that the Experiment is fitted for Uſe [a]. The *Apples covered with Crabs and Onions*, were likewiſe

[v] Heat has the ſame, or, perhaps, a greater Effect, in making the *Cream* riſe and ſeparate.

[w] Theſe are very uſeful Hints for a *Hiſtory of vinous Fermentation*; with all its Accidents, Concomitants, and Attendants.

[x] Here ſeems to be a good Foundation laid for the *Enquiry*.

[y] There is a great Advantage attending the making of *Experiments* thus in Concert; or ſeveral of them together, where the Subject will admit of it: for by this means more Light is gained by Compariſon; and the Tendency of the whole leads the ſooner to Axioms.

[z] This is a kind of Axiom. See the *Hiſtory of Life and Death*.

[a] If proper Sets of theſe Experiments were made, they might afford excellent Rules for Practice, of great Uſe in ordinary Life. And this ſhould always be remember'd, that an Experiment judiciouſly made and conſider'd, never fails of affording either *Light*, or *Advantage*, and not unfrequently both.

likewiſe well maturated: not by Heat; but becauſe the *Crabs* and *Onions* draw out the Spirits of the Apple; and ſpread them equally throughout the Body: which cures Hardneſs. So we ſee one Apple ripens ſooner againſt another; and therefore, for making *Cyder*, they lay the Apples firſt in a Heap: and ſo one Cluſter of Grapes that touches another as it grows, ripens faſter. The *Apples in Hay* and *Straw*, ripened apparently, tho not ſo much as the other; but thoſe in the Straw ripened moſt. The *Cauſe* is, that the Hay and Straw have a very low degree of Heat, yet cloſe and ſmothering; which does not dry. The *Apple in the cloſe Box* was likewiſe ripened; for all Air kept cloſe, has a degree of Warmth; as we ſee in *Wooll*, *Fur*, *Pluſh*, &c. All the former being compared with another Apple of the ſame kind, that lay by itſelf, were found more ſweet and yellow; and conſequently appeared more ripe.

Experiments of Maturation, by rolling and preſſing.

6. The rolling of Apples, *&c.* ſoftens and ſweetens them preſently; which is owing to nothing but the even Diſtribution of the *Spirits* into the Parts: for it is the unequal Diſtribution of the Spirits, that makes the Harſhneſs. But this hard rolling is a degree between *Concoction* and *ſimple Maturation*; and therefore, if you roll them but gently, about twice a-day, and continue it for ſix or ſeven Days, they might, perhaps, ripen better; and more like to the natural Maturation [b].

By Solution of Continuity.

7. Cut a Piece off the top of an Apple, and cover it; to try whether Solution of Continuity will not haſten Maturation. We ſee that where a Waſp, Fly, or Worm, has bitten; as in a Grape, or other Fruit; the Fruit will ſweeten ſoon [c]. Prick an Apple full of ſhallow Holes, and ſmear it a little with Sack, or Cinnamon-water, or Spirit of Wine, every Day, for ten Days; to ſee if the virtual Heat of the Wine, or Strong-water, will not mature it. And in theſe Trials, keep one of the ſame Fruit untouched, to compare them with [d]. See the *Articles*, CLARIFICATION, and PERCOLATION.

MEDICINE.

Of the Order in which Remedies ſhould be uſed.

1. There are many Medicines which, of themſelves, would do no good, and, perhaps hurt; but being applied in a certain Order, one after another, effect great Cures [e]. I have tried a *Remedy for the Gout*, which has ſeldom failed to drive it away in twenty-four Hours [f]. It is, firſt, to apply a *Poultis*;

[b] This Experiment may well deſerve to be tried.

[c] Does the *Bite* occaſion the Fruit to ripen faſter? Or, was it not riper before, than others of the ſame Tree; and therefore choſe by the Creature? For *Snails*, *Ants*, *Waſps*, and Inſects, ſeem to have acute Senſes, or a particular Sagacity, in diſtinguiſhing the firſt beginning of Maturity in Fruits.

[d] This Enquiry richly deſerves to be proſecuted.

[e] The following *Particulars* have regard to the *Filum Medicinale*, mentioned by the Author in the *De Augmentis Scientiarum*, Sect. X.

[f] It may deſerve a particular Enquiry, what Effects the wearing of a Lump of Brimſtone next the Skin; or the gentle rubbing of Flower of Brimſtone upon the Part affected in the Gout, will have: for very conſiderable things have been related of both, by credible Perſons.

A Poultis. *Fomentation, and* *Plaiſter for the Gout; to be uſed ſucceſſively.*

Poultis; then a *Fomentation*; and, laſtly, a *Plaiſter*. The *Poultis* relaxes the Pores, and diſpoſes the Humour to exhale. The *Fomentation* gently draws out the Humour by Vapour; becauſe of the way made by the *Poultis*; and therefore only perſpires the Humours, without drawing more to the Part: for it is a *gentle Fomentation*, and has, withal, a little Mixture of a Stupefactive. The *Plaiſter* is moderately aſtringent; which keeps back new Humours. The *Poultis alone* would make the Part more ſoft, weak, and apt to receive the Defluxion, and Impreſſion of the Humour. The *Fomentation alone*, if it were too weak, would perſpire but little, unleſs way were made by the *Poultis*; and if too ſtrong, it would attract *to* the Part, as well as *from* it. The *Plaiſter alone* would pen up the Humour, already contained in the Part; and ſo exaſperate it: and therefore they muſt all be uſed in *Succeſſion*. The *Poultis* is to lie for two or three Hours: the *Fomentation* for a quarter of an Hour, or ſomewhat more; being uſed hot, and ſeven or eight times repeated: the *Plaiſter* is to continue on, till the Part be well confirmed. The Receit of each take as follows.

The POULTIS.

2. *Boil the Crumb of the fineſt Bread in Milk, to a Pulp; add at the end, a Dram and half of the Powder of red Roſes; ten Grains of Saffron; an Ounce of Oil of Roſes: and ſpread it upon a linen Cloth, to be applied lukewarm, and continued for three Hours.*

The FOMENTATION.

3. *Take of Sage Leaves, half a Handful; of the Root of Hemlock, ſliced, ſix Drams; of Briony Root, half an Ounce; of the Leaves of red Roſes, two Pugils; boil them in two Quarts of Water, wherein Steel has been quenched, till the Liquor come to a Quart. After ſtraining, put in half a Handful of Bay-Salt. Let it be uſed with a ſcarlet Cloth, or ſcarlet Wooll, dipped in the hot Liquor; and ſo renewed ſeven times in a quarter of an Hour, or a little more.*

The PLAISTER.

4. *Take as much* Emplaſtrum Diachalciteos *as ſuffices to cover the Part; diſſolve it, with Oil of Roſes, to ſuch a Conſiſtence as will ſtick; and ſpread it upon a piece of Holland* [g].

Of Cure by Cuſtom.

5. There is a ſecret, tho unpractiſed, way of *Cure*; by accuſtoming oneſelf to what proves otherwiſe hurtful. *Poiſons* have been made familiar to ſome Perſons: Nurſes in the *Plague* are ſeldom infected: *Tortures*, by cuſtom have been made more eaſy: exceſſive Quantities of Meats, Wine, or ſtrong Liquors, have, thro' cuſtom, neither produced Surfeits, nor Drunkenneſs [h]. And, generally, chronical Diſeaſes; as Coughs, Phthiſicks, Palſies,

[g] To judge from the Appearance of theſe three Receits, they are ſafe; and are ſaid, by others, as well as the Author, to have been ſerviceable.

[h] The Conſtitution and Frame of the Body is ſo adapted, as to be capable of ſuſtaining great Exceſſes, and Wants, without Prejudice: and it ſeems to remain unknown, to what Lengths either of theſe may, by Habit and Cuſtom, be carried: inſomuch, that ſurprizing Paradoxes might

Palſies, Lunacies, &c. are moſt dangerous at firſt: therefore a wiſe Phyſician will conſider whether the Diſeaſe be *incurable*; or whether the *juſt Cure* of it be not *hazardous*; and if it be, let him have recourſe to *Palliatives*; and alleviate the Symptoms, without buſying himſelf too much with the *perfect Cure*: and this Courſe will often exceed beyond all Expectation. The Patient himſelf may likewiſe ſtrive, by degrees, to overcome the Symptoms; and ſo, by time, turn ſuffering into *Nature* [i].

Of Cure by Exceſs.

6. Divers Diſeaſes, eſpecially chronical ones, are ſometimes cured by *Surfeit* and *Exceſs*; as in Meat, and Drink, Faſting, Exerciſe, and the like. For *Diſeaſes of Continuance, get an adventitious Strength from Cuſtom*; beſides, their material Cauſe from the Humours: ſo that the *breaking of the Cuſtom, leaves them only to their firſt Cauſe*; which, if any thing weak, will fall off. Again; ſuch *Exceſſes* ſtir and excite Nature, which thence riſeth more forcibly againſt the Diſeaſe [k].

Of Cure by Motion of Conſent.

7. There is a great *Conſent* in the Motion of the ſeveral parts of the Body. Children, in Sport, will often try whether they can rub upon their Breaſt with one Hand, and pat upon their Forehead with the other; and ſometimes they will rub with both Hands, or pat with both Hands. When the Spirits, that come to the Noſtrils, expel a bad Scent, the Stomach is ready to expel by Vomit. In *Conſumptions of the Lungs*, when Nature cannot expel by Cough, Men often fall into Fluxes of the Belly, and die. So *peſtilential Diſeaſes*, if they cannot be expelled by Sweat, cauſe a Looſeneſs, that proves commonly mortal. Therefore, *Phyſicians ſhould ingeniouſly contrive, how by Motions that are in their Power, to excite internal Motions not in their Power*; and this, by *Conſent* of *Parts*: as by the ſtench of Feathers, or the like, they cure the riſing of the Mother [l].

The Cure of Diſeaſes contrary to predispoſition.

8. 'Tis a deep *Aphoriſm* of *Hippocrates*, that *Diſeaſes contrary to the Complexion, Age, Sex, Seaſon of the Year*, &c. *are more dangerous than thoſe that are concurrent.* A Man would think otherwiſe; becauſe when the Accident of Sickneſs, and the natural Diſpoſition, ſecond each other, the Diſeaſe ſhould ſeem more powerful; and ſo it is, if we ſuppoſe like Quantity of Matter: but ſuch Diſeaſes ſhew a greater Collection of Matter; as being able to overcome thoſe natural Inclinations to the contrary. And therefore, in Diſeaſes of this kind, let the Phyſician apply himſelf more to *Purgation*, than to *Alteration*; *becauſe the Offence is in the Quantity: and the Qualities will rectify themſelves* [m].

might be derived from the *Enquiry*. There are ſome ſtrange Relations to this Purpoſe, in the *Philoſophical Tranſactions*; and *German Ephemerides*.

[i] There ſeems to be ſomething very material in this Direction, worthy the regard of Phyſicians.

[k] Here are ſome uſeful Intimations given, for forming a Method of treating ſeveral *Diſeaſes*, that vulgarly paſs for *incurable*.

[l] This is a noble Enquiry, but lies greatly neglected. It is, doubtleſs, a capital Secret in Medicine, to conſtrain Nature to co-operate with the Phyſician, by means of *Averſions*. And could not ſome conſiderable Cures be wrought, by the very *Averſion which ſome People have to Phyſick?*

[m] 'Tis great pity this *Enquiry* has not been far enough purſued, to afford ſome ſure *Rules of Practice*.

Of Preparation before, and ſettling the Body after, Purging.

9. Phyſicians wiſely preſcribe *Preparatives* before *Purgation*; for Cathartics often prove very prejudicial, if the Body be not accommodated, both before and after them [n]. The Miſchief they do, for want of *Preparatives*, ariſes from the ſticking of the Humours, and their not coming clean away; which *cauſes* great Perturbations in the Body, and ill Accidents during the Purging. It alſo checks the Operation itſelf; and therefore the Buſineſs of *Preparation* is double; *viz.* (1.) to *render the Humours fluid and mature*; and, (2.) to open the Paſſages: for both theſe help to make the Humours paſs the freer. For the former purpoſe, *Syrups* are beſt; and for the latter, *Apozems*, or preparing *Broths*. *Glyſters* alſo prevent the Medicine from lodging in the Guts, and Griping. But if the Body abound with Humours, or Fat; or if the Weather be open; theſe are Preparatives in themſelves: becauſe they make the Humours more fluid. But let a Phyſician beware of Purging after hard froſty Weather; and in a lean Body, without *Preparation* [o].

The Cauſe of Miſchief after Purging.

10. As for the Miſchief after Purging, it is *cauſed* by the lodging of ſome Humours in improper Places: for *there are Humours, which lodged in certain places of the Body, are quiet, and harmleſs; but when lodged in others, do much Miſchief* [p]. Therefore 'tis proper, after Purging, to uſe Apozems, and Broths; tho not ſo opening as thoſe uſed before Purging. Alſo abſterſive Glyſters are good to conclude with; to draw away the Relicks of the Humours, that may have deſcended to the lower Region of the Body [q].

Of ſtanching of Blood.

11. Bleeding is ſtopped ſeveral ways: *firſt*, by *Aſtringents*, and *Repercuſſives*; *ſecondly*, by *drawing the Spirits and Blood, inwards*; which is done by *Cold*; as Iron, or a Stone, laid to the Neck, ſtops bleeding at the Noſe: it has alſo been tried, that putting the Teſticles into ſharp *Vinegar*, has made a ſudden Revulſion of the Spirits, and ſtanched Blood: *thirdly*, by the *Receſs* or *Sympathy of the Blood*: ſo the bleeding Part, being thruſt into the Body of a Capon, or Sheep, new cut up and bleeding, has ſtanched Blood [r]: *fourthly*, by *Cuſtom* and *Time*; ſo the Prince of *Orange*, in his firſt Hurt, by

[n] I ſuppoſe, this is chiefly meant of the *rougher Purgatives*; ſuch as *Scammony*, *Gamboge*, &c. but, for the milder; ſuch as *Manna*, *Epſom Salt*, and, particularly, the *Mineral Purging-Waters*; they ſeem to require much leſs *preparation* of the Body, and ſubſequent *Caution*. And, perhaps, it were beſt, in all Caſes, to make choice of ſuch *Purgatives* as are, in ſome degree, their own *Preparatives*; and innocent, both in their Operation and ſubſequent Effects: as the *purging Mineral Waters* ſeem remarkably to be.

[o] Upon what *Obſervations* is this Caution grounded? Phyſicians are generally cautious of purging in froſty Weather, and chuſe to defer it till ſuch Weather breaks. Here is Matter of Enquiry: but the Misfortune is, that *Practice* is headſtrong, and commonly runs before *Enquiry*.

[p] This is an excellent *Obſervation*, and the Foundation of a very important *Enquiry*. See Mr. *Boyle* on *Specific Remedies*.

[q] So common a thing as Purging is, and ſo many Hands as the Direction of it comes under; yet, what ſolid and ſettled Diſcoveries are made, with relation to it, capable of affording ſteady and juſt Rules of Practice? It has been before obſerved, and ſhould ever be remembred, that *Practice is the Touch-ſtone of Theories*.

[r] How far has this Fact been verified?

by the *Spaniſh* Boy, could find no Means to ſtanch the Blood by *Medicine*, or *Ligature*; but had the Orifice of the Wound ſtopt by Mens Thumbs, ſucceeding one another, for the ſpace of two Days; and, at laſt, the Blood retired *by Cuſtom*. There is a *fifth* Way alſo in uſe; *viz.* to let Blood in a contrary Part, by way of Revulſion [f].

12. 'Tis ever ſerviceable, *not to continue the ſame Medicine and Aliment too long*: for *Nature, by continual Uſe of any thing, comes to a Satiety and Dulneſs, either of Appetite or Working* [t]: and we ſee that a continued Uſe of hurtful things makes them loſe their Force; whence, 'tis no wonder, if good things alſo loſe their Force by cuſtom. I account Intermiſſion almoſt the ſame thing with Change; for what has been intermitted becomes, in a manner, new again [v]. *Of Change of Aliment and Medicines.*

13. 'Tis found by Experience, that in the Uſe of *Diet-drinks* of *Guaiacum*, *Sarſa*, and the like; the Patient is more uneaſy at the beginning, than after continuing the Courſe: which has made ſome of the more delicate ſort, give over in the middle; upon a Suppoſition, that if the *Courſe* was ſo irkſome as at firſt, they could never hold out to the end. But the CAUSE is, that all ſuch Courſes dry up Humours, Rheums, and the like; which cannot be dried up till they are firſt attenuated: and when the Humour is attenuated, it becomes more fluid than before; and thus offends the Body much more, till it be conſumed. And therefore Patients, under ſuch Courſes, muſt wait a due time; and not faint at the firſt [u]. *Of* Diet-drink.

14. There is a great Variety of *Foſſils*; but the *Veins of medicinal Earths* are few: the chief being *Terra Lemnia*, *Terra Sigillata*, and *Bolus Armena*; whereof the *Terra Lemnia* is the principal. Their Virtues are, to *cure Wounds*, *ſtop Bleeding*, *Fluxes*, *Rheums*, and the ſpreading of *Poiſon*, *Infection*, and *Putrefaction*: they have, of all Simples, the perfecteſt property of Drying, with little or no Mixture of any other Quality. But *Bole-Armeniac* is the coldeſt of them, and *Terra Lemnia* the hotteſt; whence the Iſland *Lemnos*, where 'tis dug, was, in the fabulous Ages, conſecrated to *Vulcan* [w]. *The Virtues of* Medicinal Earths.

[f] The due Proſecution of this Enquiry into the ſeveral Ways of ſtopping Hæmorrhages, might lead to the Diſcovery of better *Stypticks*, than are hitherto commonly known.

[t] Tho this *Aphoriſm* may poſſibly deſerve to paſs for an *Axiom*, yet it ſeems not yet drawn into *Rules for Practice*; nor, indeed, to be greatly regarded: tho, perhaps, capable of producing noble Effects in *Medicine*.

[v] Here is another rational Foundation for attempting the Cures of ſome Diſeaſes, vulgarly reputed *incurable*.

[u] This Doctrine ſeems deduced, with great Juſtneſs, from the Virtues of the Ingredients whereof *Diet-drinks* are uſually made; and from careful Obſervation of their Succeſs. Were it not proper, to apply the Author's *Method of interpreting Nature*, in many other Caſes of Phyſick? Certainly a Set of *Rules* might, with care, be ſoon deduced in this manner; but who will undertake to verify them in Practice? for *Rules* unverified, are no *Rules* at all.

[w] There ſeems to have been a conſiderable neglect in enquiring out the proper Virtues of *Earths*: ſome have attributed great Matters to them, and others allow them ſcarce any Virtues at all. The Queſtion is not to be decided by *Diſpute*, but *Experience*. And in this View let *Becher*, *Boyle*, and *Stahl* be conſulted.

Of Medicines that condenſe, and relieve the Spirits.

15. The *Turkiſh* Drink, called *Coffee*, is made of the *Coffee-berry*, having a ſtrong Scent; but not aromatical. This Liquor they take hot, and ſit at it in their Coffee-houſes; and it comforts the Brain and Heart, and helps Digeſtion. Certainly, the *Coffee-berry*, the *Root* and *Leaf* of *Betel*, the Leaf of *Tobacco*, and the Tear of the *Poppy*, or *Opium*, which the *Turks* take largely, as ſuppoſing it to give Courage; all condenſe the Spirits, and make them ſtrong and alert. But, it ſeems, they are uſed after different Manners; for *Coffee* and *Opium*, are ſwallowed down; *Tobacco*, is ſmoked; and *Betel*, is chewed in the Mouth, with a little *Lime*. Perhaps there are more of theſe, if found and well corrected: *Quære*; of *Henbane-ſeed*, *Mandrake*, *Saffron*, the Root and Flower of *Folium Indicum*, *Ambergreaſe*, the *Aſſyrian Amomum*, *Kermes*, and of all ſuch things as inebriate, and provoke Sleep. *Note*, that *Tobacco* is not taken in the Root or Seed; which are always more powerful than the Leaf [x].

Of the propereſt Simples *for* Medicines.

16. Wiſe Phyſicians ſhould diligently enquire, what *Simples* Nature yields of extreme ſubtile Parts, without Acrimony: for theſe undermine what is hard; open what is ſtopped; and gently expel what is offenſive; without too much Diſturbance. Of this kind are *Elder-flowers*; which are therefore, proper for the *Stone*: *Dwarf-pine*; which is good for the *Jaundice*: *Piony*; which is proper for Stoppages in the Head: *Fumitory*; which is good for the *Spleen*: and many others. Several Creatures bred of Putrefaction, tho ſomewhat loathſome to take, are of this kind; as *Earth-worms*, *Timber-ſows*, *Snails*, &c. and, I conceive, that the *Troches of Vipers*, and the *Fleſh of Snakes*, ſome way prepared and corrected, are of the ſame Nature. So the putrefied Parts of Beaſts; as *Caſtor* and *Muſk*; are to be placed amongſt them. We ſee alſo, that the Putrefactions of Plants; as *Agarick* and *Jews-ears*; are of great Virtue: for Putrefaction is the ſubtileſt of all Motions in the Parts of Bodies. And ſince we cannot take the Lives of Animals; which, ſome fancy would thus make us immortal; the next thing, for Subtilty of Operation, is to chuſe ſuch putrefied Bodies as may be ſafely taken [y].

A BROTH and FOMENTATION for the STONE.

A ſafe Remedy for the Stone in the Kidneys.

17. Take of *Eryngo Roots*, cleanſed and ſliced, one Dram; boil them together with a Chicken; at the end add, of *Elder-flowers* and *Marygold-flowers*

[x] It ſeems a great Neglect in *Medicine*, not to endeavour to diſcover and aſcertain the Virtues of the *Simples*. For hence Conjectures, Rumours, Traditions, and Conceits, are every Day followed in preſcribing them; inſtead of *Experiments*, *Obſervations*, *Facts*, and *Certainties*: inſomuch, that there is room to ask, whether the Virtues of any one Simple, of all the thouſands in being, are fairly manifeſted by competent Experience? If not, 'tis ſurely high time to begin the *Enquiry*; firſt by the *ſimpleſt Means*, and afterwards proceeding gradually to *Compoſitions* and *Combinations*. Let Trial, therefore, be made of *ſimple Infuſions*; of *ſimple Ingredients in Water*; of *cloſe Decoctions* of the ſame Plant; of *Robs*, *Extracts*, &c. each to be given ſeparately, and repeated at due Diſtances; without the Uſe of any other *Medicine*: for, till we know what *Virtues* the particular Parts of *Simples* have, reſpectively; how can we judge of their *Virtues* in Compoſition? Certainly this is an Enquiry, where nothing ſhould be left to Imagination; but the Conduct be ſtrictly juſt, regular and experimental. See the *Novum Organum*, Part II.

[y] Theſe are excellent Intimations; but they ſeem to be ſtrangely ſlighted.

flowers, one Pugil; of *Angelica-ſeed*, half a Dram; of *Raiſins of the Sun* ſtoned, fifteen; of *Roſemary*, *Thyme*, and *Mace* together, a little. and, in ſix Ounces of this Broth, diſſolve three Grains of *Cremor Tartar*. Every third or fourth Day, take a ſmall Toaſt dipped in new drawn Oil of ſweet Almonds, and ſprinkled with a little loaf Sugar. You may make the Broth for two Days; and take one half every Day. If you find the Stone to ſtir, forbear the Toaſt for a Courſe or two. The Intention of this Broth is, not to bring away; but to undermine the Quarry of the Stones in the Kidneys[z].

TROCHES for the STOMACH.

18. Take of the beſt *Pearls*, very finely pulverized, one Dram; of Nitre, one Scruple; of *Cremor Tartar*, two Scruples; of *Ginger* and *Gallingal* together, one Ounce and a half; of *Calamus Aromaticus*, *Ellicampane-root* and *Nutmeg* together, one Scruple and a half; of *Ambergreaſe*, ſixteen Grains; of *Muſk*, ten Grains: and by Means of *Roſe-water* thickened with *Gum Tragacanth* and the fineſt Sugar, make them into *Troches*[a]. *Stomachic Troches.*

Another Medicine to ſtrengthen the STOMACH.

19. Take *Lignum Aloes* in groſs Shavings; ſteep them in *Sack* or *Alicant*, changed twice, half an Hour at a time; till the Bitterneſs be drawn out. Then dry the Shavings in the Shade, and beat them to a fine Powder; of which, with the Syrup of Citrons, make a ſmall Pill. To be taken before Supper[b]. *A Medicine for the Stomach.*

GRAINS of YOUTH[c].

20. Take of *Nitre*, four Grains; of *Ambergreaſe*, three Grains; of *Orrice-powder*, two Grains; of *white Poppy-ſeed*, a Grain; of Saffron, half a Grain; and with *Orange-flower-water*, and a little *Gum Tragacanth:* make them into four ſmall Pills, or Grains. To be taken at four a-clock, or going to Bed. *A Medicine for procuring ſome degree of Rejuveneſcency.*

PRESERVING OINTMENT.

21. Take of *Deer's-ſuet*, one Ounce; of *Myrrh*, ſix Grains; of *Saffron*, five Grains; of *Bay-ſalt*, twelve Grains; of *Canary Wine*, two Years old, a Spoonful and a half: ſpread it on the inſide of the Shirt, let the Shirt dry, and then put it on[d]. *The Author's Ointment for long Life.*

WINE

[z] This Remedy appears to be very innocent; but how effectual, can only be learnt from *Experience.*

[a] The Intention of theſe *Troches* ſeems to be warming, and ſtrengthening to the *Stomach*; and promoting *Digeſtion.*

[b] This Receit appears to have ſome relation to the Author's *Hiſtory of Life and Death*; where he particularly enumerates the practical Methods of prolonging Life; and, amongſt other things, mentions the Introduction of a *ligneous Subſtance into the Blood:* tho the Medicine here ſet down, may otherwiſe have ſome more immediate Effect in ſtrengthening the Stomach; as the Title expreſſes.

[c] All the following *Receits* have a more direct relation to the *Hiſtory of Life and Death*; where they are, in a manner, indicated, or referred to, as means of prolonging *Life.* For the Author appears to have formed to himſelf a practical Method with ſuch a View, upon the *Doctrine*, or *Axioms*, pointed out in that *Hiſtory.*

[d] The Uſe and Intention of this Ointment may ſufficiently appear from the *Hiſtory of Life and Death.*

WINE for the SPIRITS.

His Invigorating Wine.

22. Take Gold perfectly refined, three Ounces; quench it ſix or ſeven times in good Claret Wine; and, for two Draughts, add of *Nitre*, ſix Grains; of *Saffron prepared*, three Grains; of Ambergreaſe, four Grains: paſs it thro' an Hippocras Bag, wherein there is a Dram of *Cinnamon* groſſly beaten; or, (to avoid muddying the Colour) of *Ginger*. Put two Spoonfuls of this to a Draught of freſh Claret Wine.

The Way of preparing the Saffron, is this,

Steep ſix Grains of Saffron in equal parts of Wine and Roſewater, and a fourth part of Vinegar; then dry it in the Sun[e].

WINE againſt MELANCHOLY, and for preſerving the SENSES and REASON.

His Wine againſt Melancholy.

23. Take the *Roots of Bugloſs*, well ſcraped, cleanſed, and ſeparated from their inner Pith; cut them into ſmall Slices; ſteep them in *Wine of Gold* prepared as above; add of *Nitre*, three Grains. And drink it, mixed with freſh Wine, as the above deſcribed Wine for the Spirits. *Note*, The *Roots* ſhould not ſteep above a quarter of an Hour; and muſt be thrice changed[f].

A RESTORATIVE DRINK.

His reſtorative Drink.

24. Take of *Indian Maiz*, ground and ſifted, half a Pound; of *Eryngo Roots* and *Dates*, each three Ounces; of *Ellicampane*, two Drams; of *Mace*, three Drams: and brew them with Ten-ſhilling-beer, to the Quantity of four Gallons, by boiling them in two Quarts of Wort, to be afterward mix'd with the Beer. This is to be uſed familiarly at Meals.

Againſt WASTE of the BODY, by HEAT.

His Preſervative, againſt Waſte by Heat.

25. Strain *ſweet Pomegranats*, lightly, into a Glaſs; and add, a little *Citron-peel*, two or three *Cloves*, three Grains of *Ambergreaſe*, and a due Proportion of fine Sugar. This is to be drank, every Morning, whilſt Pomegranats laſt[g].

METHUSALEM-WATER; againſt all Aſperity and Parchedneſs of the inward Parts; all Aduſtion of the Blood; and, generally, againſt the Dryneſs of Age.

His Water for prolonging Life.

26. (1.) Boil new Creviſes well, in Claret Wine; and rub the Shells very clean, eſpecially on the inſide; then waſh them, three or four times, in warm Claret, impregnated with the Tops of green Roſemary, ſtill changing the Wine till all the Fiſh-taſte be taken away: now dry the pure Shell throughly, and bring it to an exquiſitely fine Powder. (2.) Steep *Pearl* in *Vinegar* for twelve Hours, then dry off the Vinegar; and make this, alſo, into

[e] Perhaps ſome would rather preſerve the *Tincture* here, than the *prepared Saffron*: but this was not agreeable to the Deſign of the Author. Nor, indeed, can his Deſign be rightly judged of, without an Acquaintance with his *Hiſtory of Life and Death*.

[f] This is agreeable to the Doctrine delivered under the *Article* INFUSION.

[g] See the *Hiſtory of Life and Death*.

into an extreme fine Powder. (3.) Take of each Powder three Drams, a a Scruple of *Ginger*, and half a Scruple of *Poppy-ſeed*; ſteep them ſeven Hours in *Spirit of Wine*, wherein ſix Grains of Saffron have been infuſed. Then, with a gentle Heat, evaporate all the Spirit, and dry the Powder in the Sun, without Fire. (4.) Add to it of *Nitre*, one Dram; of *Ambergreaſe*, a Scruple and a half; and keep this Powder for Uſe in a clean Glaſs. (5.) Slice four Ounces of freſh pared *Cucumbers*, into two Quarts of Milk, and draw off a Water by Diſtillation. (6.) Quench *Gold* four times in a Pint of *Claret Wine*. And, (7.) to the Wine and Milk-water, each three Ounces, add a Scruple of the *Powder*; and drink it in the Morning; ſtirring up the Powder before you drink: and walk upon it [h].

METALS.

Heads of Enquiry for the particular Hiſtory of Metals.

1. The *Enquiry into Metals*, may well be accounted *capital*; for Metals are of great Service in Life. We will therefore here ſet down the *principal Heads*, that occur to us with regard to this Enquiry [i].

ARTICLE I.

Of Separation.

Metalline Separation of three general kinds.

2. Enquire into the Buſineſs of *Separation:* which is of three ſorts; *viz.* (1.) *Smelting*, or *Refining*; (2.) *Extracting*; and, (3.) *Principiating*. *Smelting*, or *Refining*, is ſeparating the pure *Metal* from its Ore, or Droſs: *Extracting*, is the educing of one *Metal* out of another: and *Principiating*, is the reſolving any *Metal* into its original or elementary Matter [k].

Viz. (1.) Smelting.

3. Let the *Enquiry of Smelting* be proſecuted thro' all the Metals, *Gold*, *Silver*, &c. and, by the way, enquire of the firſt *Stone*, *Ore*, *Spar*, *Marcaſite*, and Beds of Metals, reſpectively; what Bodies they are, and their degrees of Richneſs. Thus the richeſt *Iron-ſtone* proves hardeſt to melt; but the caſe is otherwiſe in *Tin*, and *Lead* [l].

4. En-

[h] To underſtand the Bottom of the Deſign, and full Intention of theſe ſeveral Remedies, requires a diligent Peruſal of the Author's *Hiſtory of Life and Death:* which will ſhew the Judgment of the Compoſitions; or the *inductive Foundation* upon which they ſtand. And unleſs a due regard be had to that Hiſtory, the Author will, probably, appear to have here committed ſome groſs Errors in *Pharmacy*. But his Views were very different from thoſe in directing ordinary Medicines; and regarded the *reſtoration of Youth*, and *lengthening the common Period of Life*. And this Difference of Intention, requires a very different *Pharmacy* from the common.

[i] The following Heads are drawn up in the uſual way of the Author, as a kind of *Outlines*, or *Skeleton*, of the particular *Hiſtory* of METALS, that wants but to be filled up, to appear like his own *Hiſtory of Life and Death, Winds*, &c. Certainly the Advantages of this Method are not duly underſtood by Mankind: tho a few *Inventors*, or original *Enquirers* into the Works of *Nature* and *Art*, may ſeem to have followed it. But the thing, in itſelf, is of ſuch Extent, and Utility, as, with a moderate Attention, to inſtruct Men of ordinary Capacities, to purſue *Enquires* with as much Succeſs as Men of brighter Parts: for it indicates, not only the Particulars to be *purſued*, but alſo the *Method of purſuing*, till the Enquiry neceſſarily arrives at ſome conſiderable Diſcoveries. The *Novum Organum* has diſcuſſed this Matter; and there will be more ſaid of it, in the *Introduction* to the SCALA INTELLECTUS.

[k] Theſe Particulars have been nobly proſecuted by *Becher* and *Stahl*.

[l] Conſult *Agricola de Re Metallica*, and the later Metallurgiſts; particularly the *Germans*.

Of Separation by Fire, or Depart-waters, &c.

4. Enquire into the different Ways of *Separating* by *Fire*, *Depart-Waters*, or otherwiſe: and for the Manner of *Refining*, enquire, (1.) into the Methods of increaſing the Heat; (2.) accelerating the Operation; and, (3.) ſaving of Charges. The Means are three; and depend, (1.) upon the Blaſt of the Fire; (2.) the Form of the *Furnace*; for uniting, and reflecting Heat: and, (3.) the Uſe of Additions, or Matters which help the Ore, and open it ſooner [m].

5. The Method of *quickening the Fire*, and multiplying the Heat, may be general; and ſerve alike for all Metals: but the Additions ſhou'd be different; and ſuitable to each Particular. It muſt not, however, be expected, that, by increaſing the Addition in Proportion to the *Ore*, the Yield ſhould anſwer; for Quantity, in the *Paſſive*, adds more Reſiſtance than it adds Force in the *Active*.

Of rendering the baſer Metals finer.

6. 'Tis reported by the Ancients, that there was a kind of Steel, in ſome Places, which would poliſh almoſt as white and bright as Silver; and that there was, in *India*, a kind of *Braſs*, which, when poliſhed, could ſcarce be diſtinguiſhed from Gold. This was in the *natural Ore*; but I queſtion whether Men have ſufficiently *refined the Metals* we account baſe; as, whether *Iron*, *Copper*, and *Tin*, are refined to the height: for, perhaps, when they are brought to ſuch a Fineneſs as ſerves for ordinary Uſe, Men do not try to refine them farther [n].

(2.) Extraction.

7. Under *Extraction*, enquire what *Metals* contain others: thus, Lead and Tin, contain *Silver*; Lead and Silver, contain *Gold*, &c.

8. Let it alſo be enquired, what the Difference is in thoſe *Metals* that contain more or leſs of others: thus, the Lead that contains moſt *Silver*, is accounted more brittle, and poor, than that which contains leſs.

(3.) Principiation.

9. As for *Principiation*, whether there be really ſuch a thing or no; or only a *Solution*, *Extraction* or *Converſion* by the Fire; it ſhould be carefully examined, what *ſimple Bodies* are to be found in the ſeveral Metals; and in what Quantity. Thus, *Quickſilver* and *Brimſtone* are found in ſome *Minerals*: and, particularly, *Antimony* abounds with Brimſtone; as appears upon diſſolving it in *Aqua regia*, whereby the *Brimſtone* is made to float a-top.

ARTICLE II.

Of the Changes to be wrought upon Metals.

The ſeveral Ways of changing Metals.

10. Under this Head, enquire into the Ways of *Tinging*, *Ruſting*, *Calcining*, *Subliming*, *Precipitating*, *Amalgamating*, *Vitrifying*, and *Diſſolving* of Metals in *Menſtruums*; their *Shooting*, *Sprouting*, or *Growing* into Trees; the *Methods*

[m] See *Stahl's Philoſophical Principles of univerſal Chemiſtry*; which have a direct Tendency to fill up the ſeveral *Heads* of Hiſtory here ſet down.

[n] *Regulus of Antimony* may, by repeated Operations, be refined to a great degree of Purity; ſo as to approach the Whiteneſs, tho not the Malleability of Silver. But there ſeems to be no Methods, in common Uſe, of Refining *Gold* and *Silver* beyond one certain degree; or, that of Twenty-four *Carats*, as it is called. And the ſame is to be underſtood of *Copper*, *Tin*, and *Lead*: but whether ſome chemical Operators have not *ſecret Ways* of improving or meliorating all theſe *Metals*, might deſerve to be enquired into.

Methods of Hardening and *Softening* them; making them *Tough*, or *Brittle*; *Volatile*, or *Fixed*; and Converting, or Tranſmuting them into one another.

11. Under *Tinging*, enquire how Metals may be tinged quite thorough; with what Matters, and into what Colours; as in the Tinging of *Silver*, *yellow*; *Copper*, *white*, *red*, *blue*, *green*; yet ſo as to keep its Luſtre. And this Enquiry may receive ſome Light from the *Tinging of Glaſs*, *Marble*, *Flint*, or other Stone; and ſtriking a variety of Colours thro' them. Viz. (1.) By Tinging.

12. Under the *Ruſting* of Metals, enquire, chiefly, by what Corroſives this is effected; and into what Colours the Ruſt turns: thus, *Lead* and *Tin*, corroded with *Vinegar*, turn white; *Iron*, yellow; *Copper*, green, *&c.* And all *Metals* ſeem ſubject to Ruſt; unleſs it be *Quickſilver* and *Gold:* tho Quickſilver is turned into Vermillion, by ſubliming it with Sulphur; and the *Scripture* mentions the Ruſt of Gold [o]. (2.) Ruſting.

13. Under *Calcination*, enquire how each Metal is calcined; into what kind of Body it turns; and the moſt exquiſite Way of Calcining it: thus, all Metals may be calcined by *corroſive Spirits*, or the Admixture of *Salt*, *Sulphur*, and *Mercury*; and the imperfect Metals, by the bare Continuance of Fire alone: but *Gold* and *Silver* are beſt calcined by *Mercury*. (3.) Calcination.

14. Under *Sublimation*, enquire the manner of Subliming; what Metals undergo this Operation; and what kind of Sublimate the Body makes: thus, Metals are ſublimed by joining them with Mercury, or Salts; as Silver with Mercury, Gold with Sal-Ammoniac, and Mercury with Vitriol. (4.) Sublimation.

15. Under *Precipitation*, enquire, (1.) what Addition precipitates what Metal; (2.) in what Time; and, (3.) into what Body. The principal *Additions* for this Purpoſe are, *Salt-Water* and *Oil of Tartar*. (5.) Precipitation.

16. Under *Amalgamation* enquire, (1.) what Metals endure it; (2.) what are the Means of effecting it; and, (3.) what manner of Body it makes. (6.) Amalgamation.

17. Under *Vitrification* enquire, (1.) what Metals are ſubject to it; (2.) what are the Means of effecting it; (3.) into what Colour it turns; (4.) in what Caſes the whole Metal becomes *Glaſs*; and, (5.) in what Caſes it only hangs in the glaſſy Parts; (6.) what Gravity the vitrified Part has, compared with the *Metal*; and, (7.) whether all *Metals* may be reduced from a State of Vitrification, to *Metal* again. The *imperfect Metals* are, by a ſtrong Fire, convertible into *Glaſs*; *Iron*, into a green; *Lead*, into a yellow; *Copper*, into a blue; and *Tin*, into a pale yellow Glaſs: but *Gold* and *Silver* have not been vitrified at the *Furnace* [p], unleſs joined with *Antimony*. And all theſe glaſſy Bodies are reducible to a metalline form again, by melting them with a large Proportion of freſh Metal. (7.) Vitrification.

18. Under *Diſſolution* enquire, (1.) the proper *Menſtruum* for diſſolving each Metal; (2.) what *Menſtruums* will not diſſolve them; (3.) which will diſſolve any Metal; and, (4.) which diſſolve, reſpectively, and moſt exactly. (8.) Diſſolution.

[o] Gold will be ruſted by the Fumes of *Spirit of Salt*.

[p] But they have by the Burning-glaſs. See M. *Homberg*'s Paper upon the Subject in the *French Memoirs*.

actly. Obſerve alſo, (5.) the Proceſs of the Diſſolution; (6.) the manner of the Liquor's riſing, boiling, heating, &c. (7.) the Charge that each *Menſtruum* will bear, and then ceaſe to act; (8.) the Colour it acquires: (9.) above all examine, whether there be any one *Menſtruum*, for any one Metal, that is not fretting or corroding; but opens the Body by *Sympathy*, and not by its Corroſiveneſs or Violence.

19. Gold diſſolves in *Aqua Regia*, into a *yellow Liquor*; with little Heat or Ebullition: Silver in *Aqua Fortis*, into a *green Liquor*; unleſs the *Silver* were without Alloy; and this with great Heat and Ebullition. *Mercury* diſſolves in the ſame *Menſtruums* as *Gold* and *Silver* do, without altering the Colour of the Liquor. Tin likewiſe, diſſolved in ſalt Water, alters not the Colour of the *Menſtruum*. *Lead* diſſolves white, in *Vinegar*; and leaves the *Menſtruum* ſweet. *Iron* diſſolves in any ſharp, ſaline, or *vitriolic Water*, and even in common Water; if the Metal be firſt calcined with Sulphur: it diſſolves Blood-red in *Aqua Fortis*; with a great Heat and Ebullition. *Copper* diſſolves in the ſame Liquors as *Iron*, into a blue. And *Menſtruums* may, by Skill, be charged with half their own weight of Metal.

(9.) *The* Branching *and* Sprouting *of metallic Solutions.*

20. The *Sprouting* or *Branching of Metals*, in Solution; tho it ſeem but a matter of Pleaſure; has yet a more ſerious Uſe: as it diſcovers the delicate Emotions of Spirits, when they put forth under Confinement; which is the Caſe of Vegetables: tho this Shooting of Metals ſcarce happens, but where the *Menſtruum* is over-charged [9].

(10.) Hardening *and* Softening *of Metals.*

21. Under *Hardening* and *Softening*, it muſt be enquired, what will make *Metals harder*, and what *ſofter*; and this Enquiry has two Uſes: the *firſt*, in rendring Metals more manageable by the Hammer, as *Iron* is made malleable by the Fire: the *ſecond*, as *Hardneſs* is one Step towards *Fixedneſs*; and *Softneſs*, towards *Volatility*: which are Qualities that, by this Enquiry, may give light to one another.

(11.) Toughneſs *and* Brittleneſs.

22. *Toughneſs* and *Brittleneſs*, tho things of the ſame kind with *Hardneſs* and *Softneſs*, yet deſerve a ſeparate Enquiry; eſpecially with a View of joining Hardneſs and Toughneſs: as in the making *Glaſs malleable*, and *Sword-blades*, &c. ſtrong, both to reſiſt and pierce, without being liable to break.

(12.) Volatility *and* Fixedneſs.

23. *Volatility* and *Fixedneſs*, is a capital Enquiry. The utmoſt degree of Fixedneſs, is that whereon no Fire will operate, nor Menſtruum aſſiſted by Fire; but we don't know that ſuch a *Fixedneſs* is poſſible. The next degree is, when Fire, ſimply applied, will not operate without ſome Menſtruum. The *next* is, by the Teſt. The *next* is, by a Fire unblown, or unfanned with a particular Current of Air. The *next* is, when it will not endure ſuch a Fire; but yet the Body remains malleable. The *next* is, when the Body remains brittle; but ſtupefied, without flowing. So of *Volatility*, the utmoſt degree is, when the Body flies off, without returning. The *next* is, when it flies off, but eaſily returns. The *next* is, when it flies upwards, by

[9] This Affair of the *Sprouting of Metals*, or making the *Arbor Dianæ*, or the *Silver Tree*, as it is vulgarly called, is well proſecuted by M. *Homberg*, and other Members of the *Royal Academy of Sciences at* Paris. See their *Hiſtory*, and *Memoirs*.

by a kind of Exsufflation, without Vapour. The *next* is, when it melts without rising. The *next* is, when it softens without melting. And of all these, especially in the extreme Degrees, careful Enquiry should be made, in the several *Metals*.

24. Under *Transmutation* or *Conversion*, if the Thing be real, and true, 'tis the utmost reach of Art; and should be well distinguish'd from *Extraction*, *Restoration*, and *Adulteration*. There is much talk of converting *Iron* into *Copper* [m]; and of the growth and increase of Lead; which cannot happen without a *Conversion* of some other Body into Lead. (13.) *Transmutation.*

25. In *Cyprus there is said* to be a kind of *Iron*, that when cut to pieces, and put into the Ground, will grow into larger pieces, if it be well water'd. Lead will multiply and increase; as has been found in old Stone Statues, put in Cellars; the Feet of them being bound with leaden Bands: where, after a time, the Lead has swelled so, as to hang upon the Stone like Warts [n]. And every thing of this kind, which is clear and well defined, should be carefully enquired into and recorded. (14.) *The Growth of Metals.*

ARTICLE III.

Of the Reduction, or Restoration of Metals.

26. Under this *Article*, it should first be enquired, what Bodies will never return; either, by reason of their extreme Fixation, or extreme *Volatility*. The two *Methods of Reduction* should be carefully examined, *viz.* that by *Fire*; which is but by collecting the homogeneal Parts together. The second consists in drawing the Bodies downwards, by something that has a Consent therewith: so *Iron* draws down *Copper* in Solution; *Gold* attracts *Quicksilver* in Vapour, *&c.* and whatever is of this kind shou'd be very carefully enquired into. *The two Methods of Reduction.*

27. It must likewise be examined, how far Time, or Age, will reduce, without the help of Fire, or other Addition. *Whether Time will reduce.*

28. Let it also be enquired, what prevents Union or Restitution; as when *Quicksilver* is kill'd with *Turpentine*, *Sulphur*, &c. *What hinders Reduction.*

29. And *Lastly*, let it be enquired, how the *restored Metal* differs from the *pure Metal*, that has never been destroy'd; or whether it becomes more churlish, altered in Colour, or the like. *Whether Restoration alters the Metal.*

ARTICLE IV.

Of Compounding, Incorporating, or uniting of Metals and Minerals.

30. Enquire, (1.) which *Metals* will unite with which, by barely melting them together; (2.) which thus refuse to incorporate; (3.) in what quan- *What Metals unite.*

[m] The naked Fact is, that at *Newsohl*, in *Germany*, they lay thin Plates of *Iron*, for a certain Time, in a certain *running Water*; and take them out *Copper*: some whereof I have seen, that was pure Copper thro'out. This Fact is mention'd by *Agricola*, *Varenius*, *Hoffman*, *Stahl*, and many more. And whoever would account for it, as the Humour runs, should first consider the *Phænomenon* closely: for there has been much superficial *Verbage* upon the Subject.

[n] But is this an actual Growth? Or only a flowing down of the Lead, on account of its Softness, and the Pressure acting upon it? See Mr. *Boyle* upon the *Growth of Metals*.

tity they mix; and (4.) what kind of Body the Compound proves. Thus *Gold* incorporates with Silver, in any Proportion; and, according to *Pliny*, when the Silver makes a fifth part of the whole, the Compoſition is call'd *Electrum*: which remains fixed, ponderous, and coloured, according to the proportion of the two *Metals*.

31. *Gold* eaſily incorporates with *Quickſilver*; but the product is imperfectly fix'd: ſo are all other Metals incorporated with *Quickſilver*.

32. *Gold* incorporates with *Lead*, in any Proportion; ſo it does with *Copper*; which is its common Alloy. It likewiſe incorporates with *Braſs* and *Tin*; which was the ancient Alloy: but with Iron, Gold will not incorporate [o].

33. What is ſaid of *Gold* and *Quickſilver*, holds alſo of *Quickſilver* and the reſt of the Metals; except *Iron*, with which it does not incorporate.

34. *Silver* incorporates with *Lead*, in any Proportion; as alſo with *Copper*, *Braſs* and *Tin*; but not with *Iron*: which likewiſe incorporates with no other Metal. *Lead* incorporates with *Copper*; and ſuch a mixture was the ancient *Pot-Metal*.

35. It alſo incorporates with Tin; and a mixture of theſe two, in equal proportion, was the ancient *Plumbum Argentarium*.

36. *Copper* incorporates with *Tin*; and of ſuch a mixture were the Mirrors of the *Romans* [p].

ARTICLE V.

Of the Compound Metals in Uſe, and the Proportions of their Mixtures.

Pewter, its Compoſition.

37. Fine *Pewter* conſiſts of a *thouſand Pound weight of Tin*, fifty Pounds of *Solder* or Temper, and three Pounds of *Tin-glaſs*. The *Temper* is made of four Pound and a half of the Droſs of pure *Tin*, and half a Pound of *Copper*. *Coarſe Pewter* is a mixture of fine *Tin* and *Lead*.

Braſs.

38. *Braſs* is made of *Copper* and Calamy, melted together.

Bell-Metal.

39. *Bell-metal* conſiſts of a thouſand Pound weight of *Copper*; from two to three hundred weight of *Tin*, and a hundred and fifty Pounds of *Braſs*.

Pot-Metal.

40. *Pot-metal* is *Copper* mixed with *Lead*.

Alchymy.

41. *White Alchymy* is made of a Pound of *Pan-Braſs*, and three Ounces of *Arſenick*.

42. *Red Alchymy* conſiſts of *Copper* and *Orpiment*.

Imperfect Metals.

43. There are ſeveral *imperfect Metals*, which incorporate with *Metals*; as *Calmine*, the *Pyrites*, *Miſi*, *Chalcitis*, *Sori*, *Vitriol*, &c.

Compoſitions of ſeveral Metals.

44. The *Compoſitions of three*, or more *Metals*, are too long to enquire into; unleſs there be any ſuch Mixtures already in uſe. It ſhould alſo be obſerved, whether any two *Metals*, which will not mix of themſelves, may be united by the help of another, or any third Thing [q].

Metals to mix with Foſſils.

45. Let Trial be made of *mixing certain Foſſils along with Metals*; as *Braſs* is made by mixing *Calamy* with Copper. But Metals incorporate not with Glaſs;

[o] The *Method of Gilding Iron*, ſhould be here enquired into.

[p] And of ſome ſuch a Mixture may be made the *Metal for Reflecting Teleſcopes*.

[q] There are many curious Inſtances of this in the *Sublimer Metallurgy*.

Glaſs; unleſs themſelves be firſt vitrified. Tho in all Mixtures of this kind, the quantity that comes out ſhould be well conſidered; becauſe ſome ſmall matter may incorporate, like the Alloy in Gold and Silver Coin [r].

Three particulars to be regarded in Compoſition.

46. Three Things ſhould be principally conſider'd, in a Body thus compounded, *viz.* (1.) the Colour; (2.) the Softneſs, or Brittleneſs; and, (3.) the Volatility, or Fixedneſs, in Compariſon of the ſimple Ingredients.

Rules for it in reſpect of Uſe and Profit.

47. For *preſent Uſe, or Profit*, let it be a Rule, to conſider the Price of the two Simples; and again, the Dignity of the one above the other, in Uſe; then to try if a Compound can be made thereof; whoſe lowneſs of Price ſhall countervail its want of Dignity, in Uſe. Thus for Example; conſider the Price of *Braſs-Cannon*, and compare it with the Price of *Iron-Guns*, and obſerve wherein the former excels the latter, in Uſe: then if a *compound Metal* for *Cannon* can be made of *Braſs* and *Iron*, that ſhall be nearly as good in Uſe, yet much cheaper in Price; it may be attended both with a *private* and *publick Advantage*. So again, notwithſtanding the great difference in Price betwixt *Silver* and *Gold*, yet the Dignity of *Gold* above *Silver* is not conſiderable; their Splendor is equal, and that of *Silver*, more pleaſing to ſome Eyes; as in *Cloth of Silver*, *Silver-Lace*, *Silver Sword-hilts*, &c. The principal Dignity lies here, that Gold endures the Fire better than Silver; but this is an excellency in Nature, and nothing at all in Uſe: and it appears to have no ſuperior Dignity except in this, that Things which are ſilver'd, ſully and canker more than thoſe that are *gilded:* which Inconvenience, if it could be prevented, as by a ſmall admixture of Gold, might turn to Advantage. 'Tis therefore ſtrange, that the *Electrum* of the Ancients, conſiſting of *Gold* and *Silver*, ſhould have been diſuſed for ſo many Ages; whereas it appears a very ſerviceable mixture in *Coin*, *Plate*, and *Gilding*.

Tranſmutations difficult.

48. There ſeems to be a great difficulty in the *Tranſmutation* of Metals, or the making of *Gold*, *Silver*, or *Copper* [s]; on the other hand, there is Deceit, and Villany in the Adulteration and Counterfeiting of them: but there ſtill ſeems to be a middle way, between the two, by means of *new Compoſitions*; if the ways of incorporating were but well underſtood. Let it be enquired, what *Incorporation*, or rather *Imbibition*, *Metals* will receive from Vegetables, without being diſſolved in their Subſtance; as when the *Armourers* make their Steel more tough and pliable, by ſprinkling it with Water; or the Juice of Plants: and when *Gold*, grown eager or churliſh, recovers its Softneſs, and Ductility, by the throwing in of Shavings of Leather, dreſs'd or drench'd in Oil.

But new Incorporations practicable.

Signs of Imbibition.

49. Obſerve, that in theſe and the like *apparent Imbibitions*, it were proper to try whether the Weight be increas'd: for if there be no additional Weight, we may ſuſpect there is no *Imbibition* of Subſtance; but that only the application

[r] He that goes upon reducing this Article to Practice, ſhould be well acquainted with Foſſils, and *Philoſophical Chemiſtry*.

[s] See the *Articles*, ALTERATIONS, GOLD, and TRANSMUTATION.

cation of the other Body diſpoſes and ranges the *Metal* in another ſituation of Parts, than of itſelf it would have taken [t].

The Incorporation of Metallic Solutions.

50. After the *Incorporation of Metals, by ſimple Fuſion*, the *Incorporation of their Diſſolutions* ſhould be likewiſe tried; the better to diſcover their Natures, Agreements, and Diſagreements: and ſhew what Metals, when diſſolved in their Menſtruums, will incorporate kindly together, and what not: and to this purpoſe, particular Enquiries ſhould be ſeparately made; as before in the Buſineſs of *Smelting*, or *Colliquifaction*.

Their Agreement or Diſagreement.

51. In ſuch *Solutions* as do not eaſily incorporate, the Effects ſhould be obſerved; as, whether there is (1.) any *Ebullition*; (2.) *Precipitation* to the Bottom; (3.) riſing up towards the Top; (4.) a Suſpenſion in the middle; and the like. Thus the *Solutions* of *Gold* and *Silver* diſagree; ſo that when mixed together, they cauſe great *Ebullition*, *Darkneſs*, and at length *precipitate* a black *Powder*; ſo likewiſe the *Solutions of Silver* and *Copper* diſagree; as likewiſe thoſe of *Silver* and *Lead*: but the *Solutions of Gold* and *Mercury*, and thoſe of *Silver* and *Tin*, agree. The *Solution of Gold*, likewiſe agrees with that of *Iron*; and the *Solutions* of *Mercury* and *Iron* agree with all the reſt [u].

Whether the Diſagreement be owing to the Menſtruum or the Metal.

52. Obſerve, that the diſagreement of the *Menſtruums* may prevent the Incorporation, as well as the diſagreement of the *Metals*: and therefore where the *Menſtruums* are the ſame, and yet the Metals do not incorporate, the difference muſt be in the *Metals*; but where the *Menſtruums* are different, this is not ſo certain.

ARTICLE VI.

New Compoſitions of Metals.

Of incorporating ſtony Matter with Iron.

53. Let Trial be made, whether *Iron* will incorporate with any ſtony Matter; for if it will, without too great Charge, or other Inconvenience; the cheapneſs of the *ſtony Matter*, may render the *Compoſition* profitable, and fit for various Uſes. But ſuch a Compoſition, tho it may ſerve for ordinary Uſes, and the large Works, as Stoves, Guns, Portcullifes, *&c.* cannot well be expected fit for the finer Works; as *Locks*, *Clocks*, *ſmall Chains*, &c.

Iron and Braſs.

54. Let Trial be made of incorporating *Iron* and *Braſs*; for the cheapneſs of *Iron* in Compariſon of *Braſs*, promiſes Profit; if the Uſes may be ſerved. But ſuch an Incorporation is not to be expected, upon *ſimple Fuſion*; or without ſome particular Calcination, or Addition. If ſuch a *compound Metal* would come ſufficiently cheap, it might ſerve for *Ordnance*, *Statues*, *Columns*, *Monuments*, and the like. The Experiment might be tried with *Braſs*, *Iron*, *Calamy*, and *Sulphur*; with a ſmall addition of Lead: tho the Expence is firſt to be conſider'd, leſt it ſhould eat out the Profit [v].

54. There

[t] This belongs to the *Sublimer Metallurgy*; which lies in ſo few Hands, and has been ſo obſcurely treated, that the generality of Philoſophers know not what to believe about it.

[u] Many Secrets probably lie concealed in this part of the Enquiry.

[v] There are a few conſiderable Hints to this purpoſe, in the *Philoſophical Tranſactions*, and *French Memoirs*.

55. There are two Trials to be made in the Incorporation of Metals, for Magnificence and Delicacy; the one with regard to the Eye, the other with regard to the Ear; *viz.* the one for *Statue-Metal*; and the other for *Bell-Metal*, *Trumpet-Metal*, and *String-Metal*: and tho the mixture ſhould here be dearer than *Braſs* itſelf, yet the agreeableneſs or excellence of the *Metal*, may advance the Price, to Profit. Firſt, therefore, for *Statue-Metal*, ſee *Pliny*'s mixtures, which are almoſt forgot; and conſider the Charge. Try likewiſe the mixture of Tin, in a large Proportion, with Copper; and obſerve the Colour and Beauty when poliſh'd. *New Compounds for Statue-Metal.*

56. For *Bell-Metal*, try a mixture of pure Iron, and Glaſs, and Tin; if a Method can be found to make them unite; with a mixture of Silver. And do the ſame for *String* and *Trumpet-Metal*; only omitting the *Glaſs*. Try to incorporate Silver and Tin, in equal Quantities; and two parts of Silver with one of Tin: and obſerve whether the *mixed Metal* be of equal Beauty, and Luſtre with Silver; and whether it yield no more Sullyneſs; and again, whether it will endure the ordinary Fire, like Silver Veſſels, without melting. For, if in theſe reſpects it were equal to Silver, it would be a thing of ſingular Uſe and Profit: tho perhaps it might not receive Gilding, as Silver does. *For Bell-Metal, String-Metal, &c.*

57. Enquire into the ways of *Drowning one* Metal in another, ſo as never to riſe again. By Drowning, I underſtand the mixing of a baſer Metal with a nobler, ſo that they can by no means be ſeparated. This *Drowning of Metals* is a kind of *Verſion*, tho falſe: as if Silver ſhould be inſeparably incorporated with Gold; or Copper, and Lead, with Silver. The ancient *Electrum* had, as was before obſerv'd, a fifth of Silver to the *Gold*, and made a *compound Metal*; as fit for moſt Uſes as Gold. It was more reſplendent, and better qualified in ſome other reſpects; but then the two were eaſily ſeparated. I have heard a Man, skilful in Metals declare, that a fifteenth part of *Silver* incorporated with *Gold*, cannot be recovered by any *Water of Separation*; unleſs you add a greater quantity of Silver to draw the leſs to it: which he ſaid is the laſt Refuge in Separations. But this is a tedious way, that few would think on. The Fact ſhould be enquired into [w]: and the quantity of a fifteenth turned to a twentieth, with ſome little addition; that may further the intimate Incorporation. Note, that *Silver* in *Gold* will be detected by the want of ſpecifick Gravity; but not Lead in Silver: becauſe Lead is heavier than Silver. *Of* Drowning Metals.

58. This *Drowning of Metals*, would be a thing of great Profit: for if a quantity of Silver could be ſo buried in Gold, as not to be reduced back by Fire, *Depart-Waters*, or otherwiſe; and yet the mixture ſerve all Uſes, as well as Gold; 'tis, in effect, the ſame thing as converting ſo much *Silver* into *Gold*: only the Gravity will diſcover it; tho this takes off but half the Profit: for Gold is not double the Weight; but twelve times the price of Silver.

59. This

[w] See *Fiſchini's Probier-Buchlein*; and *Stahl's Philoſophical Principles of Chymiſtry*, pag. 282, &c.

59. This *Drowning of Metals* may be attempted two ways; *viz.* either in a very ſmall Proportion, or with ſomething that may fix the *Silver* in the body of the *Gold*: for the leſs quantity is always hardeſt to ſeparate. And for the Buſineſs of fixing; it may be proper to uſe *Bone-Aſhes*, or Cupel-Duſt, or the like Body, which the Fire has no power to conſume.

The making of Gold and Silver.

60. The making of Gold is a deſperate *Project*, becauſe *Gold* is the heavieſt of Metals; to make Matter impoſſible; and to condenſe Metals, a thing hardly to be hoped for. But the making of *Silver* might more rationally be attempted; becauſe both *Quickſilver* and *Lead* are heavier than *Silver*; ſo that they require only fixing, and not condenſing. The neareſt Approximation yet known, is the plunging of *Quickſilver*, tied up in Parchment, or otherwiſe, in *melted Lead*, whilſt it cools; for this ſtupefies and coagulates the *Quickſilver*. The Experiment may, perhaps, be improved three ways; (1.) by melting the *Lead* again and again; to ſee if it will not make the *Quickſilver* ſtill harder, and harder: (2.) by putting Realgal, hot, into the midſt of the Quickſilver; whence it may be coagulated as well from within, as without; and (3.) by trying it over melted *Iron*; to ſee if this will not fix the Quickſilver more than Lead [x].

MILK.

Of increaſing of Milk in Cattle.

There is a kind of Stone, which they grind to Powder, and put into Water, whereof Cattle drink, to make them give more Milk: and there ſhould be ſome better Trials made of mixtures of Water in Ponds for Cattle, to increaſe their *Milk*, or fatten them, or keep them from the Murrain. Perhaps Chalk and Nitre are proper [y]. See the *Article* PRESERVATION, § 2.

MIXTURE.

Experiments upon the ſimple Commixture of Liquors without Heat.

1. *Spirit of Wine*, tho much lighter than Oil, mixes with common Water: but if its Fall be broke by the Interpoſition of a linen Rag, or the like,

[x] 'Tis very obſervable, that here is a noble *Philoſophical Foundation* laid for the *Hiſtory of Metals*: But certainly there are few who take in the Nature, the Extent, and Uſes of ſuch a *Hiſtory*; otherwiſe we might reaſonably expect, more ſhould have been done in it. The Misfortune lies here, that *Metallurgy* is almoſt wholly left to mechanical Hands; whilſt very few ſuch able Chemical Philoſophers as *Becher* and *Stahl* concern themſelves about it.

[y] Some uſe *Malt-Duſt*, for this purpoſe, made of a pappy Conſiſtence with *warm Water*. But the *Hiſtory of the Dairy* is greatly wanted in *Natural* and *Experimental Philoſophy*. This *Hiſtory* might ſerve as a Key to many other Enquiries. But it ſeems ſo low and vulgar a Thing in the Eyes of many; that thoſe who are otherwiſe diſpoſed to enter upon it, are hence diſcouraged from the Undertaking. Yet the *Profit* that would probably attend the Enquiry, might encourage ſome to undertake it, who are uncapable of being influenced by other Motives. To have a *double Produce of Dairy Productions* from the ſame quantity of *Milk*, is no trifling Advantage. And are the beſt ways of making thoſe ordinary Commodities, *Cheeſe* and *Butter*, diſcover'd? Cou'd not theſe Preparations be more gratefully *colour'd* and *flavour'd*, at an eaſy Expence? Cou'd not the *Yield* be greatly increaſed? Cou'd not the refuſe Liquors be turn'd to a much more conſiderable Advantage than at preſent? And, in particular, could not wholeſome potable Liquors, or a kind of Wines, and *Brandies*, be prepared from *Whey*? Theſe Things are worth examining, by ſuch as are skilled in *Chemical Operations*.

like, it remains floating a-top: yet if once mix'd, it does not, like Oil, ſeparate again. This I try'd in Water tinged with Saffron.

2. *Spirit of Wine* does not mix readily with Water; but makes a kind of clouding and waving. This was likewiſe tried with Saffron-water [z].

3. Having diſſolved a Dram of *Gold* in twelve times its Quantity of *Aqua regia*, and a Dram of *Copper* in ſix times its Quantity of *Aqua fortis*; the Solutions, when put together, exhibited a green Colour; without any viſible Motion in the Parts.

4. *Oil of Almonds*, mix'd with *Spirit of Wine*, ſeparates again; the *Spirit* floating a-top, and the *Oil* reſting at the bottom.

5. A Dram of the *Solution of Gold*, mixed with an equal quantity of Spirit of Wine, gives no apparent Alteration.

6. The *Solution of Quickſilver*, and the Solution of Gold, each in the quantity of a Dram, turn to a kind of mouldy Liquor, black, like Smithy-water. In this Caſe, the Solution of the Gold was twelve parts *Menſtruum*, and one part Metal; and that of Quickſilver was two parts *Menſtruum* to one of Metal.

7. *Spirit of Wine*, and the *Solution of Quickſilver*, being put together, each in the quantity of a Dram; at firſt threw up a white milky Subſtance to the top; but mixed ſoon after.

8. A Dram of *Oil of Vitriol*, mix'd with a Dram of *Oil of Cloves*, turns of a dark red Colour, and forms a thick Subſtance, almoſt like Pitch; and upon the firſt Motion, conceives an extreme Heat, not to be endured by the Hand.

9. A Dram of the *Solution of Gold*, and as much *Oil of Vitriol*, gathers a great Heat, at firſt; and makes a thick, muddy Liquor.

10. *Spirit of Wine*, and *Oil of Vitriol*, each in the quantity of a Dram, ſcarce mix at all; the Oil ſinking to the bottom; and the *Spirit* reſting, milky, above. The *Spirit*, however, conceives a great Heat; and becomes ſweet to the Taſte.

11. A Dram of *Oil of Vitriol*, and as much *Solution of Quickſilver*, makes a violent ſtruggle; throws up a groſs Steam, and afterwards precipitates a white kind of Curds or Sand: a ſlimy Subſtance riſing to the top, and conceiving a great Heat.

12. A Dram of *Oil of Sulphur*, and as much *Oil of Cloves*, turn into a thick and red Subſtance; tho without conceiving ſuch a Heat as *Oil of Cloves*, and *Oil of Vitriol*.

13. *Rock-Oil*, and *Spirit of Wine*, each in the quantity of a Dram, intermix as Wine and Water do, by Agitation; otherwiſe the *Rock Oil* remains a-top.

14. *Oil of Vitriol*, and *Rock-Oil*, each a Dram, turn into a mouldy Subſtance, and conceive ſome Heat; whilſt a black Cloud falls to the bottom, and a very thick Oil riſes to the top.

[z] Theſe *Experiments* occur among the Author's *Phyſiological Remains*; and probably were not intended to be publiſhed without ſome Introduction, to have ſhewn their *Tendency* and *Uſe*.

15. An Ounce of *Spirit of Wine*, and as much *Wine-Vinegar*, mix by Agitation, without manifeſtly ſeparating again; but at the firſt fall, the Spirit remains above.

16. *Oil of Vitriol*, and *Oil of Almonds*, each an Ounce, mix not; but the Oil of Almonds remains a-top.

17. A Dram of the *Solution of Iron*, and as much of *Oil of Vitriol*, firſt precipitate a milky Subſtance; and then incorporate into a mouldy one.

18. One part of *Spirit of Wine*, put to two parts of *Milk*, coagulates a little; but mixes: and the *Spirit* does not float a-top.

19. Equal quantities of *Milk* and *Oil of Almonds*, will hardly incorporate; but the *Oil* floats above, when the Milk is poured to it: and the *Milk* appears in Drops or Bubbles.

20. A Scruple of *Oil of Vitriol*, put to an Ounce of *Milk*, coagulates it at the bottom, where the *Oil of Vitriol* lies.

21. *Oil of ſweet Almonds*, and a *Solution of Gum Tragacanth*, do not mix; but the Oil remains above, till they are ſtirr'd: and this makes the Mucilage ſomewhat more fluid.

22. Half an Ounce of *Spirit of Wine*, being ſtirr'd in with an Ounce and a half of the Solution of *Gum Tragacanth*, renders the *Mucilage* thicker.

23. The *White of an Egg*, being put into *Spirit of Wine*, coagulates and hardens, as if the Egg began to poach.

24. An Ounce of *Blood* eaſily incorporates with an Ounce of *Milk*.

25. An Ounce of *Blood*, and an Ounce of *Oil of Almonds*, do not incorporate; but the Oil floats above.

26. *Spirit of Wine* curdles or coagulates Blood.

27. An Ounce of unclarified *Whey*, being put to an Ounce of *Oil of Vitriol*; there appears no viſible Alteration.

28. Three quarters of an Ounce of *Wax*, being diſſolved upon the Fire, and an Ounce of *Oil of Almonds* put to, and ſtirr'd with it; they do not ſo incorporate, but that when cold, the *Wax* collects, and floats upon the Oil.

29. An Ounce of *Oil of Almonds*, being put to an Ounce of boiling *Sugar*; they preſently ſeparate; the *Sugar* ſhooting towards *the bottom* *.

MOON.

Of the Influences of the Moon.

The *Influences of the Moon* are chiefly four; *viz.* (1.) the calling forth of Heat; (2.) the introducing of Putrefaction; (3.) the increaſing of Moiſture; and (4.) exciting the Motions of the Spirits.

(1.) For

* Theſe are but ſcatter'd or undigeſted *Experiments*, relating to a Subject of great importance in *Phyſicks*, as particularly in *Pharmacy* and *Chemiſtry*; viz. the *Agreement* and *Diſagreement* of Bodies, with regard to their *mixing* or *uniting*. It were, therefore, proper to proſecute them in *Sets* or *Claſſes*; till they pointed out the *Axioms*, or juſt Doctrine of *Mixture*, in all kinds of Fluids: whereby the Doctrine of Menſtruums, and Chemiſtry itſelf, might receive conſiderable Improvement. Something towards this Deſign has been done by Mr. *Boyle*, M. *Geoffroy*, and Dr. *Stahl*: But the *Doctrine of Mixture*, in the proper phyſical Senſe, ſeems very little underſtood; tho its Foundations were laid by *Becher*, and have been ſince illuſtrated and improved by *Stahl*.

(1.) For *drawing forth Heat*; take warm Water, and expoſe part of it to the *Moon-Beams*; and part of it with a Skreen between; to ſee whether that which ſtands exposed to the Beams, will not cool ſooner. But becauſe this is only a ſmall Interpoſition, it were proper to try it, both when the Moon ſhines, and when ſhe does not; and with warm Water in a glaſs Bottle, as well as in a Diſh; and with Cinders, red hot Iron [b], *&c.* *As to Heat.*

(2.) For introducing of *Putrefaction*; try it with Fleſh, or Fiſh, expoſed to the *Moon-Beams*; and again expoſed to the Air, when the Moon does not ſhine; for the like time: to ſee which will corrupt the ſooneſt. Try it alſo with Capon, or other Fowl, to ſee which will become tender ſooner. Try it with dead Flies or Worms, caſting a little Water upon them; to ſee which will putrefy firſt. Try it with an Apple, or Orange, having Holes made in them; to ſee which will rot, or grow mouldy ſooneſt. Try it with Cheeſe, having Wine put into it; to ſee which will breed Mites or Maggots ſooner, or larger [c]. *Putrefaction.*

(3.) For the *increaſe of Moiſture*; the received Opinion is, that Seeds, Hedges, Herbs, Hair, Nails, *&c.* grow quickeſt if ſet, or cut, in the increaſe of the Moon: alſo that the Brains of Rabbets, Woodcocks, Calves, *&c.* are plumpeſt in the full of the Moon: and ſo of Marrow in the Bones, and the Bodies of Oyſters and Cockles [d]. Set any Seeds, or Roots, ſome of them immediately after the Change, and others, of the ſame kind, immediately after the Full; in the ſame Earth, or in Pots: let the Pots alſo ſtand where no Rain or Sun can come at them; leſt the difference of the Weather confound the Experiment: and ſee in what time the Seeds ſet in the increaſe of the Moon, come to a certain height, and how they differ from thoſe ſet in the decreaſe. Probably the Brain of Man grows moiſter, and more turgid at the Full of the Moon: it were therefore proper for thoſe that have moiſt Brains, or are great Drinkers, to take the Fume of *Lignum Aloes*, Roſemary, Frankincenſe, *&c.* about the *Full of the Moon.* The Humours alſo in Mens Bodies may increaſe and decreaſe with the Moon; whence it were convenient to purge a Day or two after the Full; for then the Humours will not repleniſh ſo ſoon again. *Moiſture.*

(4.) As for *exciting the Motion of the Spirits*; obſerve that the growth of Hedges, Herbs, Hair, *&c.* is cauſed from the Moon, by exciting the Spirits, as well as by increaſing the Moiſture. But for the Spirits in particular, the great INSTANCE [e] is in *Lunacies.* There may be other ſecret Effects of the influence of the Moon, not yet brought under Obſervation [f]. *And Motion of the Spirits.*

[b] Have theſe Experiments been made, with Care and Accuracy? Or have not Philoſophers, from their Theories, generally thought them too trifling to be tried?

[c] There have been ſtrange Things related of this Operation of the Moon: but I do not find them verified.

[d] Are the Facts here mention'd, determined to this Day; any farther than by a general Application of the *Doctrine of the Tides*, as cauſed by the Moon, to all Fluids, as well as the Sea-Water?

[e] See the *Doctrine of* INSTANCES, in the *Novum Organum*, Part II.

[f] See Mr. *Boyle's Apology for Aſtrology*, in his *Memoirs for a general Hiſtory of the Air.* See alſo the *De Augment. Scientiar.* Sect. IV.

Perhaps if the Wind be North, or North-East, in the Full of the Moon, it increaſes Cold; and if South, or South-Weſt, it diſpoſes the Air, for a conſiderable time, to Warmth and Rain: which ſhould be obſerved. Probably Children, and young Cattle, that are generated or brought forth, in the *Full* of the Moon, are ſtronger and larger than thoſe brought forth in the *Wane*: if ſo, it might be good Husbandry to put Rams and Bulls to the Females, ſomewhat before the *Full of the Moon.* Perhaps, alſo, Eggs laid in the Full of the Moon, breed the better Birds; and many of the like Effects may be brought into Obſervation. *Quære* alſo, whether Thunders, and Earthquakes, happen not moſt in the Full of the Moon[g].

MOTION.

Motion of Gravity *and* Levity.

1. The Ancients call'd the *Motion of Gravity* and *Levity* by the Name of *natural Motion*; becauſe they perceived no external Efficient thereof, nor any apparent Reſiſtance: and it alſo ſeem'd to be very quick in its Progreſs. This inſipid Conceit has borrowed ſome Seaſoning from that *Mathematical Notion* of the Adheſion of heavy Bodies to the Earth's Centre, in Caſe the Earth were perforated; and again, from that *Scholaſtic Fiction* of the Motion of Bodies to their own places. And when Men had laid down this, they thought they had done the Buſineſs; and looked out no farther: except here and there one, who more diligently enquired out the *Centre of Gravity* in Bodies of different Figures; and the Motion of Bodies in Water. Nor have the Moderns perform'd any thing to purpoſe upon this Subject; beſides adding a few mechanical Diſcoveries; and thoſe too diſtorted and perverted by their Demonſtrations. But for the Thing itſelf; 'tis certain, that *Body* can ſuffer from nothing but *Body*; and that no local Motion can happen without an exciting Cauſe, proceeding either from the Parts of the Body moved; the adjacent, contiguous, or approaching Bodies; or, at leaſt, ſuch as lie within their Sphere of Activity. It was not, therefore, amiſs in *Gilbert* to introduce *magnetical Virtues*; only himſelf alſo became Magnetical, and drew too many Things by thoſe Virtues; ſo as to build a *Ship* out of a ſingle *Stick*[h].

Motions *by Imitation.*

2. Motions paſs from one Man to another, not ſo much by exciting the Imagination, as by Imitation; eſpecially if there be an aptneſs or inclination before. Whence, Yawning and Stretching paſs from Man to Man; being cauſed, when the Spirits are a little heavy, or oppreſs'd, by any Vapour, or the like; whilſt the Spirits ſtrive, as it were, to wring out and expel that which oppreſſes them. So Men drowſy, and deſirous to ſleep, or before the Fit of an Ague, uſually yawn and ſtretch; ſending out at the ſame time a Voice or Sound, which is a natural *Interjection of Expulſion:* ſo that if another be prepared to do the like, he follows by Aſpect: and thus the laughing of one Perſon, makes another laugh, *&c.* See the *Article* SYMPATHY.

3. Birds

[g] We have here the Foundation of a very important *Enquiry*, wherein *Natural Philoſophy, Medicine, Agriculture, Husbandry*, &c. are nearly concerned. And yet this Enquiry lies ſtrangely neglected; ſo that in the Matters relating to it, we proceed upon *Rumours*, and *Traditions*, inſtead of ſound *Experience*, and well digeſted *Obſervation*.

[h] This was deſign'd as an *Introduction* to the *particular Hiſtory* of *Gravity* and *Levity*; but the *Work* was never publiſhed.

3. Birds move ſwifter than Beaſts; becauſe, the Stock of Spirits in Birds may be greater, in proportion to the Bulk of their Bodies. *The quickneſs of* Motion *in Birds.*

4. Put Water into a Glaſs; wet your Finger, and draw it round the edge of the Glaſs, ſomewhat hard; and the Water will friſk, and ſprinkle up, in a fine Dew. This ſhews the Force of Compreſſion in a ſolid Body: for whenever a Solid is preſs'd, there is an inward Tumult in the Parts thereof, tending to deliver themſelves from the Compreſſion: and this is the CAUSE of all violent Motion. It is very ſtrange that this Motion has never been obſerved, and enquired into; as being the moſt common, and the chief Origin of all mechanical Operations. *Experiments relating to the Motion of Bodies upon Preſſure.*

5. This Motion operates firſt in a Round, by way of Proof and Trial, which way to deliver itſelf; and then in Progreſſion, where it finds the Deliverance eaſieſt [h]. In Liquors, this Motion is viſible; for all Liquors when ſtruck, make round Circles, and daſh: but in Solids it is ſo ſubtile, as to be inviſible; yet manifeſts itſelf by many Effects, as in the preſent Inſtance. For the Preſſure of the Finger, promoted by the wetting, ſoon ſets all the ſmall Parts of the Glaſs at work; ſo that they ſtrike the Water briskly: whence proceeds the ſprinkling.

6. If you ſtrike a ſolid Body, that is brittle; as Glaſs, or Sugar; it breaks not only in the part where the immediate Force acted; but ſhivers every way: the Motion here ſearching in all Directions, and cauſing the Body to break where it was weakeſt. *Upon Percuſſion.*

7. Gunpowder, fired from a Cannon, and thus dilated into Flame, that does not endure Compreſſion, moves likewiſe in a Round; (as being of the nature of a Fluid;) ſometimes recoiling; ſometimes breaking the Piece; but generally diſcharging the Bullet: becauſe it there finds the leaſt Reſiſtance. *In the Firing of Gunpowder.*

8. This Motion upon Preſſure, and its reciprocal *viz.* Motion upon Tenſion, we call *Motion of Liberty* [i]; that is, when a Body, being forced to a preternatural Extent, delivers, and reſtores itſelf to the natural: as a blown Bladder, when preſs'd, riſes again; or Leather, or Cloth, when ſtretch'd, ſprings back. This Motion upon Preſſure, is manifeſt alſo in Sounds; as when a Bell is ſtruck: but as ſoon as the Hand is preſſed upon it, the Sound ceaſes: ſo, the Sound of a Virginal-ſtring ſtops when the Quill of the Jack falls down. For theſe Sounds are produced by the ſubtile Percuſſion of the minute Parts of the Bell, or String, upon the Air; as Water is made to leap, by the ſubtile Percuſſion of the minute Parts of the containing Glaſs [k]. See the *Articles* GRAVITY and IMPULSE. *Motion of Liberty.*

MUSICK.

[h] The Author's Doctrine of Senſe and Senſibility, ought to be remembered on this, and many other Occaſions: otherwiſe ſome of the modern Philoſophers may imagine, he attributes *mental Properties* to *Matter*. See *De Augment. Scientiar.* Sect. X. 9—11. See alſo the *Article* DIVINATION, above.

[i] See Motions claſſed in the *Novum Organum*, Part II. Sect. II.

[k] The *Doctrine of Motion*, ſo far as it is here conſidered, ſeems to have received very little Improvement ſince the time of our Author. And tho the general Subject of Motion has been laudably

MUSICK.

A Specimen of a proper Enquiry into Muſick.

1. The *Practice of Muſick* has been well purſued; and in good variety: but the *Theory* weakly; eſpecially as to aſſigning the *Cauſes* of the *Practice:* being alſo reduced to certain myſtical Subtilties, of no Uſe, and but little Truth. We ſhall, therefore, after our manner, here join the *Theoretical* and *Practical* Parts together [1].

Sounds divided into Muſical *and* Immuſical.

Tones what in the phyſical Senſe.

2. All *Sounds* are either *muſical*, or *immuſical*. The *muſical* are otherwiſe call'd *Tones*; which may be accompanied with a *Harmony*; and are ever equal; as in *Singing*, the *Ringing* of Bells, *&c.* But the *immuſical Sounds* are ever *unequal*; as the Voice in Speaking, Whiſpering, all Percuſſions of Stone, Wood, Parchment, Skins, *&c.* The Sounds that produce *Tones*, always ariſe from ſuch Bodies, as are equal; in their Parts and Pores ſuch are the Percuſſions of Metal, as in Bells; of Glaſs, as in the filliping of a Drinking-Glaſs; of Air, as in Mens Voices, whilſt they ſing; in *Pipes*, *Organs*, *ſtringed Inſtruments*, &c. and of *Water*, as in the *Nightingal-Pipes* of *Organs*; and other hydraulick Machines uſed by the Ancients, but now loſt. And if any Man think, that the *String of the Bow*, and the *String of the Viol*, are neither of them equal Bodies, and yet produce Tones; it is a Miſtake: for the Sound is not created between the *Bow* and the *String*; but between the *String* and the *Air*. Whence there are, in effect, but three Percuſſions that create *Tones*; viz. (1.) The *Percuſſion of Metals*, comprehending Glaſs, and the like; (2.) the *Percuſſion of Air*; and (3.) the *Percuſſion* of *Water*.

Produced by three Percuſſions.

The Diapaſon *what.*

3. The *Diapaſon*, or *Eighth* in *Muſick*, is the ſweeteſt *Concord*; being in effect an *Uniſon:* as we ſee in *Lutes*, that are double-ſtrung in the baſs Strings, one an *Eighth* above the other; both which make but as it were one Sound. And every *eighth Note* in Aſcent, as from *eight to fifteen*, from *fifteen* to *twenty two*, and ſo on *in infinitum*, are but Scales of the *Diapaſon*. The *Cauſe* is dark; and has not been hitherto aſſign'd. It ſeems that *Air*, the *medium of Sounds*, admits of great variety in them: as we ſee in the Voices of living Creatures; and ſeveral Men, who are diſcernable by their Voices; and in the Combination of Letters, whence articulate Sounds proceed; which of all others are moſt various. But in the Sounds that are always equal, that is *Tones*, the Air is unable to caſt itſelf into any ſuch variety; but is forced to recur into one and the ſame Figure, only differing in *greatneſs* and *ſmallneſs:* as Figures, may be made of Lines, crooked and ſtrait, in infinite variety, where there is inequality; whilſt *Circles*, *Squares*, or

The Cauſe *of* Uniſons *in every* eighth Note.

laudably cultivated, by the later *Mathematicians*; perhaps there ſtill remain many Particulars in it, pointed out by the Lord *Bacon*, which neither they, nor the modern *Philoſophers*, have duly proſecuted. See the *Novum Organum*, Part II. Sect. II. and the Doctrine of Motion and moving Principles, in the *Philoſophia Prima* hereafter, Vol. III.

[1] Profeſſed Muſicians ſeldom regard more than the *Practice*; and *Philoſophers* ſeldom more than the *Theory of Muſick:* whence few ſeem to have aim'd at giving a juſt *Hiſtory* of the Subject; that ſhould at once ſatisfy the Mind, with *Cauſes*; and lead to farther Improvements, in *Practice*.

or *equilateral Triangles*, which are all Figures, can differ only as to great or leſs [m].

4. But what ſhews there is nothing in the *number Eight*, to create the *Diapaſon*; this *Computation of Eight* is a Thing rather *received* than *true*: for a *true Computation* ſhould always be by diſtribution into equal Proportions. Now there intervene, in the riſe of Eight, two *Bee-Molls*, or *half Notes*: ſo that to divide the *Tones* equally, the *Eight* is but *ſeven whole* and *equal Notes*: and to ſubdivide that into half Notes, as in the Stops of a Lute, it makes *thirteen*. Yet in the ordinary *Riſes* and *Falls* of the human Voice, (not meaſuring the Tone by whole Notes, and half Notes, which is the equal meaſure) there are alſo two *Bee-Molls* between the *Uniſon* and the *Diapaſon*: and this *variation is natural*. For if a Man would endeavour to raiſe or fall his Voice, by half Notes, like the Stops of a Lute, or by whole Notes alone, without halves, as far as an Eighth; he cannot do it: which ſhews, that *after every three whole Notes, Nature requires, for all harmonical Uſe, one half Note to be interpoſed.* *That the Effect is not owing to the Number.*

5. Again, whatever Virtue there is in *Numbers*, conducing to concent in Notes, it ſhould be rather aſcribed to the *ante-Number*, than to the *entire Number*; becauſe the Sound returns after *ſix*, or after *twelve*; ſo that the *ſeventh* or the *thirteenth* is not the Thing, but the *ſixth* or *twelfth*: and the *ſeventh* and *thirteenth* are but the Limits and Boundaries of the Return.

6. The *Concords in Muſick*, which are perfect, or ſemiperfect, between the *Uniſon* and the *Diapaſon*, are (1.) the *fifth*; which is the moſt perfect; (2.) the *third*; (3.) the *ſixth*, which is more harſh; and (4.) according to the Ancients, and ſome Moderns, the *fourth*, which they call *Diateſſeron*. As for the *tenth*, *twelfth*, *thirteenth*, and ſo on *in infinitum*, they are but Recurrences of the former; *viz.* of the *third*, the *fifth*, and the *ſixth*; being an *Eighth* reſpectively from them. *The Concords in Muſick.*

7. For *Diſcords*; the *ſecond* and the *ſeventh* are, of all, the moſt diſagreeble in Harmony; the one being next above the *Uniſon*, the other next under the *Diapaſon*: which ſhews, *that Harmony requires a competent Diſtance of Notes.* *The Diſcords.*

8. In *Harmony*, if there be no *Diſcord* to the *Baſs*, it does not diſturb the Harmony, tho there be a *Diſcord* to the higher Parts; provided the *Diſcord* be not of the two that are odious: and therefore the ordinary *Concent* of four Parts, conſiſts of an *Eighth*, a fifth and third to the *Baſs*: but that *fifth* is a *fourth* to the *Treble*, and the *third* is a *ſixth*. The Reaſon is, that the *Baſs* ſtriking more Air, overcomes and drowns the Treble; unleſs the Diſcord be very diſagreeable, and ſo covers a ſmall Imperfection: As we find one of the lower Strings of a *Lute*, gives not the Sound of the *Treble*, or any mixt Sound, but the Sound of the *Baſs*. *The Doctrine of* Baſs *and* Treble.

9. We have no *Muſick of Quarter-Notes*; and perhaps they are not capable of Harmony: for the *Half-Notes* themſelves do but ſometimes interpoſe. Yet we have ſome *Slides* or *Reliſhes* of the Voice, or String, as it were, *No Muſick of quarter Notes.*

[m] Being *Similar Figures*, as the *Geometricians* call them.

were continued without Notes, from one *Tone* to another; riſing or falling; which are delightful.

The Cauſe of Harmony.

10. We may receive ſome light, with regard to the *Cauſes* of what is pleaſing or diſpleaſing to the Ear, from what is ſo to the Sight. There are two things pleaſing to the Eye; *viz. Colours* and *Order*. The pleaſure of *Colour* ſymbolizes with the pleaſure of any ſingle *Tone*; but the pleaſure of *Order* ſymbolizes with *Harmony*. Therefore in *Garden-knots*, the Frets of Houſes, *&c.* equal Figures, as *Globes*, *Pyramids*, *Cones*, *Cylinders*, &c. are pleaſing; whilſt unequal *Figures* are but Deformities. And the pleaſures both of the *Eye* and of the *Ear*, are but the effects of Equality, good Proportion, or Correſpondence: ſo that, without queſtion, *Equality and Correſpondence are the* CAUSES *of Harmony* *.

Why muſical Sounds are more wakeful than others.

11. *Tones* are not altogether ſo apt to procure Sleep, as ſome other Sounds; *viz.* the *Wind*, the purling of *Water*, the humming of *Bees*, &c. The Reaſon is, becauſe *Tones*, being equal, and not ſliding; ſtrike and prick the Senſe more than the other: and Attention always hinders Sleep.

Muſick has its Tropes and Figures.

12. There are in *Muſick* certain Tropes or Figures, almoſt like thoſe of *Rhetorick*; and agreeing with the Affections of the Mind, and the other Senſes. Thus, the *Diviſion* and *Quaver*, which pleaſe ſo much in *Muſick*, have an Agreement with the *glittering of Light*; as when the Moon-beams play upon a Wave. Again, the *falling from a Diſcord* to a *Concord*, which makes great Sweetneſs in *Muſick*, has an Agreement with the Affections, that are gratefully reinſtated, after ſome Diſlike: it agrees alſo with the Taſte; which is ſoon glutted with what is ſweet alone. The ſliding from the *Cloſe* or *Cadence*, agrees with that Figure in *Rhetorick* called *præter Expectatum*; for there is a Pleaſure even in being deceived. The *Reports* and *Fuges* agree with thoſe Figures in *Rhetorick*, called *Repetition*, or *Traduction*. The *Tripla's*, and *changing of Times*, agree with the *Changes of Motions*; as when *galliard Time* and *meaſure Time*, meet in the Medley of one Dance.

Whence the great Influence of Muſick upon the Mind.

13. It has been anciently obſerved, that the *kinds of Muſick have a great Operation upon Men's Manners*; ſo as to rouze the Courage, or make them warlike: and again, ſoft or effeminate; grave or light; gentle, and inclined to pity, *&c.* for the *Senſe of Hearing* ſtrikes the Spirits more immediately than the other Senſes do, and more incorporeally than the *Smelling*: the *Sight*, *Taſte*, and *Feeling*, having not their Organs ſo ſuddenly and immediately acceſſible to the Spirits, as the *Hearing* has. The *Smell*, indeed, works alſo immediately upon the Spirits; and is forcible while the Object laſts; but it comes only with a Communication of the Breath, or the Vapour of the Object: whereas *Harmony* entring eaſily, without mixing at all; and coming with a manifeſt Motion; it, by the cuſtom of often affecting the Spirits, and putting them into one kind of Poſture, greatly alters their Frame, even when the Object is removed. Whence *Tunes*, and *Airs*, even in their own Nature, have ſome Affinity with the Affections; as there

* See Mr. *Hutchinſon's Enquiry into our Ideas of Beauty and Virtue.*

there are *merry Tunes*, *doleful Tunes*, *ſolemn Tunes*, *Tunes inclining to Pity*, *warlike Tunes*, &c. no wonder, therefore, if they alter the *Spirits*; conſidering that *Tunes* in themſelves have a Prediſpoſition to the Motion of the Spirits. But it has been noted, that tho this variety of *Tunes* diſpoſes the Spirits to a variety of Paſſions conformable to them; yet, generally, *Muſick* feeds that Diſpoſition of the Spirits which it finds. We ſee alſo, that different *Airs* and *Tunes*, pleaſe different Nations and Perſons; according to the *Sympathy* ſuch Tunes have with their Spirits [p]. See the *Article* SOUNDS.

N.

NATURE.

The Variety of Opinions about the Spirits *of Bodies.*

1. THE Knowledge of Man has hitherto been determined by the Sight; ſo that whatever is inviſible, either in reſpect of the Fineneſs of the Body itſelf; the Smallneſs of its Parts; or the Subtilty of its Motion; is little enquired into [q]: yet theſe are the things that principally *govern Nature*, and, without which, we can have no true *Analyſis*, and Indication of her Proceedings. The *Spirits* reſiding in all tangible Bodies are ſcarce known, and ſometimes Men take them for a *Vacuum*; whereas they are the moſt active of Bodies. Sometimes, again, theſe Spirits are taken for *Air*; from which they differ, as much as *Wine* from *Water*; or *Wood* from *Earth*. Sometimes Men will have them to be *natural Heat*, or a Portion of *elementary Fire*; tho ſome of them are crude and cold. Others will have them to be the *Virtues* and *Qualities* of the tangible Parts; which they ſee: whereas they are things by themſelves. Others, in treating of *Plants*, and *Animals*, call theſe Spirits, *Souls*: and ſuch ſuperficial Speculations Men have; like Perſpectives, which ſhew things hollow that are only Paintings.

Spirits; their Nature and Properties.

2. Nor is this a Queſtion of Words, but infinitely material in Nature: for *Spirits are no other than a natural Body, rarified to a certain degree, and included in the tangible Parts of Bodies, as in a Cover.* They are no leſs different from one another, than the denſe or tangible Parts: and they reſide more or leſs in all tangible Bodies: they are ſcarce ever at Reſt: and from them, and their Motions, principally proceed *Arefaction*, *Colliquation*, *Concoction*, *Maturation*, *Putrefaction*, *Vivification*, and moſt of the Effects of *Nature*: for *tangible Parts*, *in Bodies*, *are ſtupid Things*; *whilſt the Spirits*, *in effect*, *do all* [r].

The Difference of tangible Parts in Bodies.

3. As to the Differences in the tangible Parts of Bodies, the Chemiſts have given us ſome light; in diſtinguiſhing, by their Separations, between the *oily*, *crude*, *pure*, *impure*, *fine*, and *groſs* Parts of Bodies. And Phyſicians acknowledge, that *Herbs* and *Drugs* have different Parts; as that *Opium* has

[p] Here is a Foundation laid for a *philoſophical Hiſtory of Muſick*; a thing, perhaps, ſtill wanting, in its due Form and Extent; notwithſtanding M. *Perault's Eſſais Phyſiques, du Bruit*; and Mr. *Malcolm's* excellent *Treatiſe of Muſick, ſpeculative, practical, and hiſtorical.*

[q] This Subject requires a cloſe Attention; and, if duly proſecuted, might unravel ſome of the greateſt Myſteries in Nature: and effectively contribute to increaſe the Power of Man.

[r] See the *Fable of* Proſerpina, *explained*; in the Author's *Sapientia Veterum.*

a ſtupefactive and heating Part; that *Rhubarb* has purging and aſtringent Parts, *&c.*

The Enquiry not duly proſecuted, with regard to ſubtile Differences.

4. But this whole *Enquiry* is weakly and negligently purſued. The more *ſubtile Differences* of the minute Parts, and the Poſition of them, in Bodies, are not touched upon. And for the *Motions of the minute Parts* of Bodies, which produce ſuch great Effects, they have not been obſerved at all; becauſe inviſible, or not ſubject to the Eye; but yet they are to be catched by *Experience*. And ſo the Tumult in the Parts of Solids, when compreſſed; which is the *Cauſe* of all flight in Bodies thro' the Air, and of other mechanical Motions; is not ſeen. But if we enquire not attentively and diligently, we ſhall never diſcern, much leſs produce, a great number of *mechanical Motions*.

And the internal Proceſſes of Bodies.

5. Laſtly, *Corporeal Motions*, within the Encloſures of Bodies, whereby the Effects paſs between the *Spirits* and the *tangible Parts*, as in *Arefaction*, *Colliquation*, *Concoction*, *Maturation*, &c. are not at all touched; but put off by the Names of *Virtues*, and *Natures*, and *Actions*, and *Paſſions*; and ſuch other logical Terms [s]. See the *Article* SPIRITS.

NITRE.

Abundance of Nitre on certain Shores.

Near the Caſtle of *Caty*, and by the Wells of *Aſſan*, in the Country of *Idumæa*; a great part of the way, one would think the Sea near at hand, tho it be far off. This is cauſed by the ſhinning of the *Nitre* upon the Sea-ſand; ſuch abundance of it the Shores there afford [t].

NOURISHMENT.

The Nouriſhment of Animals, before they are brought forth.

'Tis a Work of Providence, that the Yolk of the Egg conduces little to the Generation of the Bird; but only to its *Nouriſhment*: for, if a new-hatched Chicken be opened; much of the Yolk will be found remaining. And 'tis neceſſary that Birds, which are not formed in the Womb, ſhould have in the Egg, as well Matter of *Nouriſhment*, as of *Generation*. For after the *Egg* is laid, and ſevered from the Body of the Hen, it receives no more Nouriſhment from the Hen; and only a quickening Heat, when ſhe ſits. But Men, and Brutes, need no Matter of Nouriſhment within themſelves; becauſe they are formed in the Womb of the Female, and nouriſhed continually from her Body [v]. See the *Article* FOODS.

O.

[s] The whole of this *Enquiry* ſtill remains ſtrangely neglected, to the great Diſadvantage of *Natural Philoſophy*; which ſeems, almoſt, a *dead Thing*, for want of it. The Deſign might, perhaps, be commodiouſly proſecuted under the *Name* and *Notion* of the *Chemiſtry* of *Nature*; ſo as to treat all the *Natural Operations* according to the Analogy they bear to the artificial ones, within our own *Power* and *Command*. The Misfortune is, that few ſeem well enough acquainted with *Chemiſtry* to judge of this *Analogy*, and *Conformity*: whence many will preſently conclude it an *imaginary Scheme*.

[t] There is a curious Paper upon the *Origin of Nitre*, in the *French Memoirs*, An. 1717. that may add great Light to this *Particular*.

[v] This Article may be referred to Comparative-Anatomy: a Subject that has not yet been duly proſecuted in the philoſophical Way; notwithſtanding the Diſcoveries of *Harvey*, *Highmore*, *Malpighi*, &c. See *Memoires de l'Academie Royale, pour ſervir à l'Hiſtoire des Animaux*.

O.

ODOURS.

1. HEat is requiſite to concoct the Matter of ſweet *Odours*; and ſome Moiſture to ſpread the Breath of them. For Woods and Spices are more odoriferous in hot Countries; and Things too much dried, loſe their Sweetneſs: and Flowers, when growing, ſmell better in the Morning or Evening, than at Noon. Some ſweet Odours are deſtroyed by approaching to the Fire; as *Violets*, *Wall-flowers*, *July-flowers*, *Pinks*, and, generally, all Flowers that have cool and delicate *Spirits*. Some continue their Odour both over the Fire, and from it; as *Roſe-water*, &c. Some Odours ſcarce iſſue, at leaſt not ſo pleaſantly, without the Fire; as Juniper, ſweet Gums, and all Odours incloſed in a firm Body. But, generally, thoſe Smells are moſt grateful, where the degree of Heat is ſmall; or the ſtrength of the Odour allay'd: for ſuch things rather court the Senſe, than ſatiate it. And hence, the Smell of *Violets* and *Roſes*, exceeds that of Spices and Gums in Sweetneſs; and the ſtrongeſt ſort of Smells are beſt in a Waft, at a diſtance [v]. *Sweet Odours of different kinds.*

2. No Odour iſſues without ſome Emiſſion of corporeal Subſtance; contrary to what happens in *Light*, *Colours*, and *Sounds* [w]: for Odours ſpread not to that diſtance as they do. 'Tis true, ſome Groves of Oranges, and Heaths of Roſemary, will ſmell far off at Sea, perhaps twenty Miles; but a Peal of Ordnance will extend as far; tho the Ordnance ſtand in a little ſpace; whereas theſe fragrant *Woods* and *Heaths* are of a vaſt compaſs. Beſides, Odours adhere to hard Bodies; as in perfumed Gloves, *&c.* which ſhews them corporeal; and thus continue a great while: which Sounds and Light do not. *The corporeal Subſtance of* Odours.

3. The Excrements of moſt Creatures ſmell ill, chiefly to the Creature that voids them: Pigeons and Horſes thrive beſt, if their *Houſes* and *Stables* are kept ſweet. The ſame holds of Cage-birds; and chiefly in thoſe Creatures that feed upon Fleſh. Dogs, among Brutes, principally delight in fetid Odours; which ſhews, there is ſomewhat particular in their ſenſe of Smelling. But Cats are cleanly Creatures; and bury their Excrement. The *Cauſe* why Excrements ſmell ill, is manifeſt: for, ſince the Body itſelf rejects them; much more the Spirits: and we find the Excrements of the *firſt Digeſtion* ſmell the worſt; as thoſe of the Belly: but thoſe of the *ſecond Digeſtion* better; as the *Urine*: and thoſe of the *third*, ſtill better; for *Sweat* is not ſo ill-ſcented as the other two, eſpecially the Sweat of ſome Perſons, that are full of Heat [x]. *The Cauſe of fetid and fragrant* Odours.

4. Like-

[v] Obſerve all along the *phyſical Foundations* for the *Hiſtory of Odours*. Thus, in the preſent Caſe, there is a Foundation laid, for comparing *Odours* with *Sounds*; ſo far as they are both conveyed by the ſame *Medium* of *Air*.

[w] This may be queſtioned of Light, attended with Flame; but not, ſo well, where no Flame is; as in the *Glow-worm*, *putrefied Fiſh*, &c.

[x] The Sweat of ſome Perſons is ſweet-ſcented; nearly approaching to that of Muſk or Civet. See Mr. *Boyle* upon *Odours* and *Effluvia*.

Whence Putrefactions are ill-ſcented.

4. Likewiſe, moſt *Putrefactions* yield an odious Scent; being either fetid or mouldy. The *Cauſe* may be, that *Putrefaction* is a Conſiſtence directly oppoſite to that of the Body, whilſt ſound; as being a mere Diſſolution of its Form. Beſides, the Objects that pleaſe any of the Senſes, have ſome Equality, and Order, in their Compoſition: but where theſe are wanting, the Object is always ungrateful [y]. So a Mixture of many diſagreeing Colours, is diſpleaſing to the Eye; Mixture of Diſcords, diſpleaſing to the Ear; Mixture of many Taſtes, diſpleaſing to the Palate; and Ruggedneſs of Bodies, diſpleaſing to the Touch: but all *Putrefaction*, being a Diſſolution of the firſt Form, is a mere Confuſion, and unformed Mixture of the Parts.

Why ſome Putrefactions are Perfumes.

5. But it ſeems to croſs the former Obſervation, that ſome *Putrefactions*, and *Excrements*, yield excellent Odours; as *Civet*, *Muſk*, and *Ambergreaſe*: and the Moſs of the Apple-tree, is little better than an Excretion. The *Reaſon may be*, that there paſſes in the *Excrements*, and remains in the *Putrefaction*, ſome fine Spirits; eſpecially from Creatures that are very hot [z]. This may be joined with a farther *Cauſe*, which is more ſubtile; *viz.* that the Senſes delight not to be over pleaſed; but to have a Mixture of ſomewhat, in itſelf ungrateful. *Diſcords*, *in Muſick*, falling upon *Concords*, make the ſweeteſt Harmony: and ſtrange Taſtes delight the Palate; as *Red Herrings*, *Caviar*, *Parmezan*, &c. And, perhaps, the ſame holds in *Smells*: for the *Odours* above-mentioned, are all ſtrong, and vellicate the Senſe. We find alſo, that the places where Men urine, have commonly ſome Smell of Violets; and the Urine, after eating Nutmeg, hath it likewiſe [a].

Powerful Operations of Effluvia.

6. Apothecaries, upon powdering *Coloquintida*, have been put into a great Scouring, by the bare Effluvia of that Drug. It is a Practice to *burn Guinea-pepper*; which has ſuch a ſtrong Spirit, that it provokes a continual Sneezing in thoſe that are in the Room [b].

The Effects of Fumes, or Vapours.

7. Proper *Fumes* will dry and ſtrengthen the Brain, and ſtop Rheums and Defluxions; as thoſe of Roſemary, *Lignum Aloes*, and *Calamus Aromaticus*, taken in at the Mouth and Noſtrils: and, no doubt, there are other Vapours that moiſten, refreſh, and are proper in burning Fevers, Conſumptions, and want of Sleep; ſuch, for inſtance, as *Roſe-water*, *Vinegar*, *Violets*, *Vine-Leaves* [c], &c. And, in ſudden Faintings, to put a Handkerchief, dipped in Roſe-water, or a little Vinegar, to the Noſe, collects again the *Spirits*, which were upon the Point to reſolve and fall away.

8. The Fume of *Tobacco* comforts the Spirits, and diſpels Wearineſs; partly by opening, but chiefly by its narcotick Virtue; which condenſes the Spirits.

[y] See the *Article* MUSICK.

[z] See the *Article* PUTREFACTION.

[a] Mr. *Boyle* ſeems to have directly proſecuted this Subject, on the Footing here laid down. See his Pieces upon the *Mechanical Production* of *Taſtes and Colours*, and the *Nature*, *Properties*, *and Effects of Effluvia*.

[b] The burning of *Guinea-Pepper*, in a cloſe Room, is ſaid to kill *Bugs*: but, if this be tried, 'tis proper the Operator ſhould quit the Room as ſoon as ever the Pepper is thrown upon the Coals.

[c] This is an uſeful Intimation to Phyſicians; who might, by this Means, procure Effects in Diſeaſes that they now ſeem to deſpair of. See the *Proceſſes upon Vegetables*, in *Boerhaave's Chemiſtry*.

I

Spirits. It were, therefore, proper to try the Fumes of other things, in the ſame way of *Smoking*; as well to dry and refreſh, as for other Intentions. For a drying Fume, uſe *Roſemary* and *Lignum Aloes:* try alſo Nutmeg, *Indian* Leaf [d], *&c.* 'Tis uſual, in Fits of the Mother, to burn Feathers, and other Matters of a diſagreeable Odour, with good effect.

The Fumes of the Earth recommended.

9. To follow the Plough has been approved, for refreſhing the Spirits, and procuring Appetite: but to do it in the Ploughing for Wheat or Rye, is not ſo good; becauſe the Earth has ſpent its ſweet Breath in Vegetation, during the Summer. 'Tis, therefore, better to do it when they ſow Barly. But becauſe Ploughing is confined to Seaſons, 'tis beſt to take the Air of the Earth, new turned up; by digging with the Spade, or ſtanding by the Digger. Ladies may promote their Health, by kneeling upon a Cuſhion and Weeding. And both theſe may be practiſed in the beſt Seaſon, which is the early *Spring*, before the Earth puts forth: and the ſweeteſt Earth ſhould be choſe for the Purpoſe. It ſhould be done when the Dew is a little gone off the Ground; leſt the Vapours prove too moiſt. I knew a great Man, who was long lived, and had a Clod of Earth brought him every Morning, as he ſat in Bed; where he would hold his Head over it a good while.

The Odours of Pomanders, ſweet-Bags, &c.

10. They uſe, in Medicine, Pomanders, and Knots of Powders, for drying up Rheums, comforting the Heart, provoking Sleep, *&c.* For tho theſe things are not ſo ſtrong as Fumes, yet they may be held continually in the Hand: whereas *Fumes* can be uſed but at certain times. Beſides, many things breathe better of themſelves, than when they come to the Fire; as *Nigella Romana*, the Seed of *Melanthium*, *Amomum*, &c.

Vapours for cooling and condenſing the Spirits.

11. There are two things which internally *cool* and *condenſe* the Spirits; and I recommend the ſame to be tried externally in Vapour. The *one* is *Nitre* [e]; which I would have diſſolved in *Malmſey*, or *Greek* Wine, and the Smell of the Wine received; or, to make it more forcible, pour ſome of it upon a heated Fire-ſhovel, as they do *Roſe-water* and *Vinegar*. The *other* is the diſtilled *Water of Wild-poppy*, which may be mixed in equal Parts with *Roſe-water*; and ſo received, with the Addition of a few Cloves, in a Perfuming-pan [f]. The like might be done with the diſtilled *Water of Saffron-flowers*.

The Effects of high Perfumes.

12. The Scent of *Muſk*, *Amber*, and *Civet*, are thought to promote *Venery*; which they may do by refreſhing and calling forth of the Spirits. Incenſe, and nidorous Smells; ſuch as thoſe of Sacrifices, were thought to intoxicate the Brain, and diſpoſe Men to *Devotion*; which they may do, partly by a kind of Sadneſs, or Contriſtation of the Spirits; and partly by heating and exalting them. Among the *Jews*, the principal *Perfume* of the *Sanctuary* was forbid all common Uſes. There are ſome *Perfumes* pre- *Perfumes procuring Dreams.*
ſcribed by Writers of *Natural Magick*, which procure pleaſant Dreams; and others, they ſay, that procure *prophetical Dreams*; as the *Seeds of Flax*, *Fleawort*, &c.

13.

[d] Could not an agreeable Fume be contrived, better ſuited to the Cure of certain Diſtempers, than the common Tobacco?

[e] See more upon the Subject of Nitre, in the Author's *Hiſtory of Life and Death*.

[f] I do not know that theſe Things have been tried.

That Odours may nouriſh.

13. 'Tis certain, that *Odours* nouriſh, in a ſmall degree; eſpecially the Odour of *Wine:* and we ſee Men in Hunger, delight to ſmell hot Bread. 'Tis reported of *Democritus*, that when he was near dying, he heard a Woman of the Family complain, ſhe ſhould be kept from a Feaſt ſhe greatly deſired to ſee, on account that there would then be a dead *Corpſe* in the Houſe. The Philoſopher, therefore, cauſed new Loaves to be ſent for; which he opened, poured a little Wine into them; and ſo kept himſelf alive with their Scent, till the Feaſt was over. I knew a Gentleman, who would ſometimes faſt entirely for three, four, or five Days; but then he uſed to have, continually, a great Bundle of Herbs, that he ſmelled to; and, amongſt them, ſome eſculent ones, of a ſtrong Scent; as *Onions*, *Garlick*, *Leeks*, and the like[z].

The Effects of Air and Odours, with regard to Health.

14. There are certain Airs, which Phyſicians adviſe their Patients to, in certain Diſeaſes, and upon recovering from long Illneſſes; *viz.* where the Country is open, and not overgrown with Heath, *&c.* or elſe, near Foreſts, and the like. 'Tis noted alſo, that Groves of Bays cure a peſtilential Diſpoſition in the Air; which was accounted a great Cauſe of the wholeſome Air of *Antioch*. Some Soils alſo, yield odoriferous Herbs ſpontaneouſly; as wild Thyme, wild Marjoram, *&c.* where Briar-roſes ſmell almoſt like Muſk-roſes: and theſe are Signs of an excellent Air. Men ſhould endeavour to have healthful Air in their Houſes; which they never can have if the Rooms be low roofed, or full of Windows and Doors; for the one makes the Air cloſe, and ſtagnant; and the other makes it exceedingly unequal: which is a great Enemy to Health. The Windows, alſo, ſhould not be high up to the Roof; which is only for Beauty; but low. Stone Walls, alſo, are unwholeſome: but Timber is more wholeſome; and eſpecially Brick. It has been practiſed, with good Succeſs, to make the Walls thick; and to throw a Layer of Chalk between the Bricks, to prevent Dampneſs.

Odours, why ſweeteſt at a Diſtance.

15. *Odours* are ſweeter at ſome Diſtance in the Air, than near the Noſe; becauſe of the finer Mixture, or Incorporation of the Smell: as Sounds are ſweeteſt, when we cannot hear every part, by itſelf. Another Reaſon is, becauſe all ſweet Smells have ſome earthy or crude Odour joined along with them: whence the Sweetneſs, which is the more ſpiritual, is perceived at ſome diſtance; whilſt the earthy part reaches not ſo far.

Why ſtrongeſt in dry Bodies.

16. *Sweet Smells* are moſt forcible in dry Subſtances, when broken; ſo in Oranges and Lemons, the nipping of the Rind, ſends out their Odour powerfully: and, generally, when Bodies are moved, or ſtirred, tho not broken, they ſmell the more; becauſe there is a greater Emiſſion of the Spirit, when way is made. But a ſecond *Cauſe* is, the Impulſe of the Air, that brings the Scent faſter upon us. The fineſt Smells, among *Flowers*, are of that kind where the Leaf is not ſweet; as in *Violets*, *Roſes*, *Wall-flowers*, *July-flowers*, *Pinks*, *Wood-bines*, *Vine-flowers*, *Apple-blooms*, *Bean-blooms*, &c. For where there is Heat and Strength enough in the Plant to make the Leaves odoriferous, the Smell of the Flower is rather weaker, than that of the Leaves; as in

[z] Is there not ſomething of conſiderable Uſe, both to Phyſicians and others, delivered in this Paragraph?

in *Roſemary-flowers*, *Lavender-flowers*, &c. But where there is leſs Heat, the Spirit of the Plant is digeſted, refined, and ſevered from the groſſer Juice, in the Efflorescence, and not before. But Flowers preſſed or beat, loſe the Freſhneſs and Sweetneſs of their Odour: for when cruſhed, the groſſer and more earthy Spirit comes out with the finer, and troubles it; whereas, in ſtronger Odours there are no ſuch degrees of the Iſſue of the Smell.

17. The Nature of *Orris-root* is almoſt ſingular; for there are few *odoriferous Roots*: and in thoſe that are any thing ſweet, 'tis only the ſame Sweetneſs with the Wood or *Leaf*: but *Orris* is not ſweet in the Leaf; neither is the Flower ſo ſweet as the Root; which ſeems to have a delicate and tender Heat; that vaniſhes upon coming above Ground, and feeling the Sun and Air; being a great Mollifier, and ſmelling like a Violet [h]. *Orris, ſweet chiefly in its Root.*

P.

PAINTING THE BODY.

THE *Turks* have a black Powder, made of a Mineral called *Alcohole*; which, with a fine Pencil, they lay under their Eye-lids, ſo as to colour them black; whereby the *White of the Eye* is ſet off whiter. With the ſame Powder they colour, alſo, the Hairs of their *Eye-lids*, and *Eye-brows*, which they draw into Arches. And *Xenophon* relates, that the *Medes* uſed to paint their Eyes. The *Turks*, with the ſame Tincture, black the Hair of their Heads and Beards. And many with us, who are grown grey, and yet would appear young, make their Hair black, by combing it with a *Leaden-comb*; or the like [i]. The *Chineſe*, who are olive-coloured, paint their Cheeks Scarlet; eſpecially the *Emperor* and *Grandees*. Generally, barbarous People, that go naked, not only paint themſelves, but pounce and raiſe their Skin, ſo that the Painting cannot be taken out; and make it into Works [k]. So do the *Weſt-Indians*; and ſo did the ancient *Picts* and *Britons*: whence it ſeems, that Men would have the Colour of Birds Feathers, if they could; or, at leaſt, gay Skins, inſtead of gay Clothes. *The Cuſtom of painting the Body, in different Nations.*

PASSIONS.

1. The *Paſſions of the Mind*, make the following *Impreſſions* upon the Body. *Fear* cauſes, (1.) *Paleneſs*; (2.) *Trembling*; (3.) Erection of the *Hair*; (4.) *Starting*; and, (5.) *Shrieking*. 1. The *Paleneſs* proceeds hence, that the Blood runs towards the Centre, to ſuccour the Heart: 2. the *Trembling* hence, that *The Impreſſions made by the Paſſions of the Mind, upon the Body. In* Fear.

[h] This Subject of Odours in Plants, is proſecuted in *Boerhaave's Chemiſtry*, upon the Foundation here laid down. See the *Proceſſes upon Vegetables*. See alſo, the *Article* INFUSION, above; and Mr. *Boyle's Philoſophical Works*.

[i] But a much better Way for this Purpoſe, is to uſe the *common Solution of Silver*, well diluted with Water: which appears to be the Preparation, ſold in *London*, for turning red, or other coloured Hair, to a beautiful brown or black.

[k] This is frequently practiſed, by pricking Holes in the Skin with a Needle, and rubbing pulverized Gunpowder upon the Part.

that by the flight of the Spirits inwards, the external Parts are deſerted and forſaken. 3. *Erection of the Hair*, is cauſed by the cloſing of the Pores of the Skin; whence the Hair, that before lay aſlope, muſt needs riſe. 4. *Starting* is both an Apprehenſion of the Thing feared; and an Enquiry, in the Beginning, what the Matter ſhould be; whence it is both a Motion of *Shrinking*, and a Motion of *Erection:* therefore, when a Man would liſten ſuddenly to any thing, he ſtarts; for the *Starting* is an *Erection of the Spirits*, to attend. 5. *Shrieking* is an appetite of expelling that which ſuddenly ſtrikes the Spirits; for many Motions, tho unable to expel what is hurtful, are yet Offers of Nature, and cauſe Motions by conſent; as in Groaning, or crying out, upon Pain [k].

Grief. 2. *Grief*, and *Pain*, cauſe (1.) *Sighing*; (2.) *Sobbing*; (3.) *Groaning*; (4.) *Screaming*; (5.) *Roaring*; (6.) *Tears*; (7.) *Diſtortion of the Face*; (8.) *Grinding of the Teeth*; and, (9.) *Sweating*. 1. *Sighing* is cauſed by drawing in a greater Quantity of Breath, to refreſh the Heart that labours; like taking a large Draught when one is thirſty. 2. *Sobbing* is the ſame thing, but ſtronger. 3, 4, 5. *Groaning*, *Screaming*, and *Roaring*, are cauſed by an *Appetite of Expulſion:* for when the *Spirits* cannot expel the offending Subject in ſtriving to do it by Motion of Conſent; they expel the Voice: and this happens when the Spirits yield, and ceaſe to reſiſt; for, if we conſtantly reſiſted Pain, we ſhould not groan. 6. *Tears* are cauſed by a Contraction of the Spirits of the Brain, conſtringing the Moiſture thereof; whence Tears are ſent into the Eyes: and this Contraction, or Compreſſion, cauſes alſo wringing of the Hands; for wringing is a Geſture of expreſſing Moiſture. 7. The *Diſtortion of the Face* is cauſed by a Struggle; firſt, to bear and reſiſt, and then to expel; which makes the Parts firſt knit, and afterwards open. 8. *Grinding of the Teeth*, is likewiſe cauſed by collecting the Spirits to reſiſt; which makes the Teeth, alſo, ſet hard one againſt another. 9. *Sweating* alſo, is a compound Motion, from the labour of the Spirits; firſt to reſiſt, and then to expel.

Joy. 3. *Joy* cauſes, (1.) a Chearfulneſs and Vigour in the Eyes; (2.) Singing, Leaping, Dancing, and ſometimes Tears. All theſe are the Effects of the Dilatation and Eruption of the Spirits into the external Parts; which makes them more lively and briſk. *Exceſſive ſudden Joy* has cauſed preſent Death; while the Spirits diffuſed themſelves ſo much, they could not retreat again. *Tears* are the Effects of compreſſing the lachrymal Glands, upon the Dilatation of the Spirits: for Compreſſion of the Spirits cauſes an Expreſſion of the Moiſture of the Eyes by conſent, as in Grief: but, in Joy, it works by propelling the Moiſture, when the Spirits dilate, and occupy more room [l].

Anger. 4. *Anger* cauſes, (1.) *Paleneſs* in ſome; and the *going and coming of the Colour* in others: alſo, (2.) *Trembling*; (3.) *Swelling*; (4.) *Foaming at the Mouth*; (5.) *Stamping* with the Feet, and bending of the Fiſt. 1. *Paleneſs*, and

[k] 'Tis worth obſerving, how cloſe and ſtrong the Foundations are here laid, for a *Philoſophical Hiſtory of the Paſſions.*

[l] See *Boerhaave's Inſtitutiones Medica*, pag. 278. *De Voce, Loquela, Cantu, Riſu*, &c.

and the *going and coming of the Colour*, are cauſed by the heat of the Spirits about the Heart; which, to refreſh themſelves, call in more Spirits from the outward parts. And, if the *Paleneſs* be alone, without ſending forth the *Colour* again, it is commonly joined with ſome *Fear:* but, in many, there is no *Paleneſs* at all; only a Redneſs about the Cheeks; which ariſes from ſending forth the Spirits in an Appetite of Revenge. 2. *Trembling*, in *Anger*, proceeds likewiſe from a calling in of the Spirits; and happens, commonly, when *Anger* is joined with *Fear*. 3. *Swelling* proceeds from a Dilatation of the Spirits by over-heating; and from a Liquifaction, or boiling of the Humours thereupon. 4. *Foaming at the Mouth* proceeds from the ſame *Cauſe*; being an Ebullition. And, 5. *Stamping*, and *clenching of the Fiſt*, proceeds from an Imagination of the *Act of Revenge*.

Diſpleaſure.

5. Light *Diſpleaſure*, or *Diſlike*, cauſes, (1.) ſhaking of the Head; (2.) Frowning, and Knitting of the Brows. Theſe Effects ariſe from the ſame *Cauſes* as Trembling and Horror; *viz.* the retiring of the Spirits; but in a leſs degree. For, 1. the *Shaking of the Head* is but a ſlow and definite Trembling; and a Geſture of ſlight Refuſal: we ſee alſo, that Diſlike often cauſes that Geſture of the Hand we uſe upon refuſing a thing, or warning it away. 2. The *Frowning* and *Knitting of the Brows*, is a gathering of the Spirits, to reſiſt in ſome meaſure: and *Knitting of the Brows* follows upon earneſt thought of any thing, tho it be without Diſlike.

Shame.

6. *Shame* cauſes (1.) *Bluſhing*; and, (2.) a *down-caſt Look*. *Bluſhing* is the Reſort of Blood to the Face; which, in the Paſſion of Shame, is the Part that labours moſt. And, tho Bluſhing will appear in the whole Breaſt, if naked, yet it is but in paſſage to the *Face*. The *Down-caſt of the Eyes* proceeds from the Reverence a Man bears to others; ſo that, when he is aſhamed, he cannot endure to look ſtedfaſtly upon them: and both *Bluſhing* and the *Caſting-down of the Eyes*, are greater when we appear before a number; and, likewiſe, when we come before great or reverend Perſons [m].

Pity.

7. *Pity* ſometimes cauſes, (1.) Tears; and, (2.) a Side-caſt of the Eye. *Tears* here come from the ſame Cauſe they do in Grief: for *Pity* is but Grief in another's Behalf. The Side-caſt of the Eye, is a Geſture of Averſion; or an Unwillingneſs to behold the Object of Pity.

Wonder.

8. *Wonder* cauſes, (1.) Aſtoniſhment, or an immoveable Poſture of the Body; (2.) caſting up of the Eyes, and lifting up of the Hands. *Aſtoniſhment* is cauſed by fixing the Mind upon one Object of Thought; whence it does not expatiate as uſual: for, in *Wonder*, the Spirits fly not, as in Fear; but only ſettle, and become leſs apt to move. *Caſting up of the Eyes*, and *lifting up of the Hands*, is a kind of Appeal to the Deity; or the Author, by his Power and Providence, of great Wonders.

Laughing.

9. *Laughing* cauſes a *Dilatation of the Mouth and Lips*; *a continued Expulſion of the Breath, with a loud Noiſe*; *which makes the Interjection of Laughter*; *and, if violent and continued, Shaking of the Breaſt and Sides*; *and running of the Eyes with Water*. *Laughing* can ſcarce properly be called a

[m] *Ore Pompeii quid mollius? Nunquam enim non coram pluribus erubuit.*

Paſſion; as having its Source from the *Intellect*: for, in Laughing, there always preceeds a Conceit of ſomewhat ridiculous: and therefore is proper to Man. The *Cauſe of Laughing* is but a light Touch of the Spirits; and not ſo deep an Impreſſion as in other *Paſſions*: whence it may be excited, and that in great Violence, barely, by tickling ſome Parts of the Body: and Men, even in a grieved ſtate of Mind, cannot, ſometimes, forbear Laughing. It is always joined with ſome degree of Delight: and therefore has an Affinity with Joy; tho it be a much lighter Motion [n]. Its *Objects* are Deformity, Abſurdity, a witty Turn, or the like.

10. As to the *Cauſes* of the Effects before-mentioned; *viz.* the *Dilatation of the Mouth and Lips*; *the continued Expulſion of the Breath and Voice*; and *the Shaking of the Breaſt and Sides*; they all proceed from the ſudden Dilatation of the Spirits. *Suddenneſs* has here a great Share: for any ſhrewd Turn that lights upon another; or any Deformity, *&c.* moves Laughter in an *Inſtant*; which, after a little time, it does not: thus, we cannot laugh at a ſtale Jeſt; but only while 'tis new. And, even in *Tickling*, if you tickle the Sides, and give Warning; or give a hard or continued Touch; it does not move *Laughter* ſo much.

Luſt. 11. *Luſt* occaſions a *Flagrancy in the Eyes*, and a *Priapiſm*. The *Cauſe* is, that in *Luſt*, the *Sight* and the *Touch* are the Things deſired; and therefore the Spirits reſort to thoſe Parts which are moſt affected. And note, in general, that the Spirits, in all Paſſions, reſort moſt to the Parts that labour moſt, or are moſt affected; as, in the laſt mentioned, they reſort to the Eyes and Parts of Generation: in *Fear* and *Anger*, to the Heart: in *Shame*, to the *Face*: and, in ſlight *Diſlikes*, to the *Head* [o].

PENETRATION.

The reſtleſs Nature of Things, and their Deſire to change, and enter into one another.

The *Emptineſs* of ſeveral Bodies, and their Appetite to take in others, is a deep Conſideration. *Air* takes in Light, Sounds, Smells, and Vapours, with a kind of Thirſt; as not ſatisfied with its own Conſiſtence: elſe it would never receive them ſo ſuddenly, and eaſily. *Water*, and all Liquors take up dry and terreſtrial Bodies; and dry Bodies drink in Waters, and Liquors: that one is a *Glue* to the other. *Parchments*, *Skins*, *Cloth*, &c. drink in Liquors; tho themſelves are entire Bodies, and not comminuted, as Sand and Aſhes are; nor, apparently, porous. *Metals* themſelves, readily receive the *Aquæ fortes*; and the *Aquæ fortes* readily penetrate into *Metals* and *Stones*. That *Menſtruum* will touch Gold, which will not touch Silver; and *vice verſa*. Nay *Gold*, which ſeems to be the cloſeſt and moſt ſolid Body in Nature, greedily drinks in *Quickſilver*. And it ſeems that this *Reception of other Bodies is not violent*: for 'tis often *reciprocal*; and as it were, with conſent. Of the CAUSE hereof, and to what AXIOM it may be referred, conſider

[n] *Res ſevera eſt verum Gaudium.*

[o] The Author has many things relating to the *Hiſtory of the Paſſions*, in his *Sapientia Veterum*, and *Moral Eſſays*. See alſo, the *De Augment. Scientiar* Sect. II. or the *Fable of Bacchus*. And again Sect. XX and XXI. of *Ethicks*, &c. Conſult likewiſe Mr. *Hutchinſon*'s late *Diſcourſe of the Paſſions*.

ſider attentively [q]. For the quaint Aſſertion, that *Matter, like a common Strumpet, covets all Forms*, is but a roving Notion. Flame alone, takes in no other Body; but either overcomes or turns other Bodies into it, as by Conqueſt; or dyes, and goes out itſelf [r]. See the *Articles*, NATURE, SPIRITS, and SYMPATHY.

PERCOLATION.

The return of Saltneſs in Pits upon the Sea-ſhore.

1. 'Tis obſerved in ſome Parts of *Africa*, that after a time, the Water in Pits, dug on the Sea-Shore, will grow brackiſh again. For at length the very Sand, thro' which the Salt-water paſſes, becomes ſaline; and ſo the Strainer itſelf is infected. The Remedy therefore is, to dig new Pits when the old grow brackiſh; and thus change the Strainer.

Experiments for the ſweetning of Sea-Waters by Percolation.

2. If a Pit be ſunk upon the Sea-ſhore, deeper than the *Low-water Mark*; but with its Mouth ſomewhat above the *High-water Mark*; as the Tide comes in, the Pit will fill with Water, freſh and potable. This is commonly practiſed upon the Coaſt of *Barbary*; where other freſh Water is wanting. The Thing was alſo put in Practice by *Cæſar*, who when beſieged in *Alexandria*, having the Sea-Water turn'd upon the Wells; thus ſaved his Army in Deſpair. But *Cæſar* miſtook the *Cauſe*, in ſuppoſing that all Sea-Sands had natural Springs of freſh Water; for the Pit here fills, as the Tide riſes.

3. *Salt-Water* has been paſſed thro' Earth, and ten Veſſels, one within another; yet without loſing its Saltneſs, ſo as to become potable: but *Salt-Water*, ſtrained thro' a greater number of Veſſels, has become freſh: which Experiment ſeems to croſs that other of Pits, tho but in part; if it be true, that more Repetitions do the Thing [s].

[q] The *vulgar Phyſicks* ſcarce takes notice of any ſuch Thing as that here mention'd; tho it may deſervedly ſeem to conſtitute the very Eſſence of *Natural Philoſophy*; as ſhewing by what particular Powers, and Principles, all material Things are *ſeparated*, and *held together*. Certainly the *Doctrine* of *Menſtruums*, which has hitherto been chiefly confined to a few *Chemical Operations*, ſhould be ſet free, and extended to all *Natural Bodies*; ſo as to diſcover the Laws of their *Coheſion*, *Union*, *Separation*, *Mixture*, and *Converſion*; or the whole *Proceſs of Nature*, in conſerving and repairing, and changing the *Bodies of the Univerſe*: the phyſical CAUSES whereof will probably be found to be numerous *particular Laws* of *Attraction* and *Repulſion*; as, for want of more preciſe and accurate Notions, we are obliged to call them. And if, at length, the whole of this comprehenſive Doctrine can be reduced to an AXIOM; might not that AXIOM contain the true, *phyſical*, or *efficient Cauſe of the various Forms and Appearances of Bodies?* But this is anticipating too much; unleſs it were to intimate what Diſcoveries are ſtill behind; and might be rationally expected, if the *Author's Method of Enquiry* were diligently purſued.

[r] This Subject highly deſerves a vigorous Proſecution: and by way of opening to the Enquiry, it might be proper to conſult the Chapter of *Menſtruums* in *Boerhaave's Chemiſtry*. The *Philoſophical Tranſactions*, the *French Memoirs*, Mr. *Boyle*, Dr. *Hook*, and Sir *Iſaac Newton*, afford ſome Hints to this purpoſe; eſpecially with regard to the *Converſion of Bodies into Light, and Light into Bodies*, &c.

[s] This Method of Percolation *per aſcenſum*, thro' ſo large a Bed of Sand as the Difference betwixt low and high Water Mark, is impracticable at Sea; whence certain *Precipitations*, and *Diſtillations*, have been propoſed for ſweetning Salt-Water in long Voyages: But theſe Methods alſo

ſeem

Why Experiments are often fruitleſs.

4. 'Tis here worth noting, what poor Imitations are made of Nature, in the common Courſe of Experiments; unleſs conducted by Judgment, and ſome good Light of Axioms [t]. For *firſt*, there is a great difference between paſſing *Water* thro' many ſmall Veſſels; and thro' ſuch a ſpace, as between *Low-water*, and *High-water Mark*. *Secondly*, there is a great difference between *Earth*, and *Sand*; for all Earth holds a kind of nitrous Salt [u], from which *Sand* is free. Beſides, Earth does not ſtrain the Water ſo fine as Sand. *Laſtly*, in tranſmitting the *Sea-Water* into Pits, the Water riſes; but in the Tranſmiſſion of it thro' Veſſels, it falls. Now the ſalter part of Water goes to the bottom: and, therefore, no wonder if the ſtraining of *Sea-Water* by *Deſcent*, ſhould not make it freſh. Again, the very daſhing of the *Water*, if it comes from the Sea, is more proper to ſtrike off the Salt part, than when the Water ſlides of its own Motion [v].

The Advantages of Separation by Percolation.

5. *Percolation* ſeems a good kind of Separation; not only of thick from thin, and groſs from fine; but of more ſubtile Natures. It alſo varies according to the Body thro' which it is made; thus, thro' *Woollen*, the Liquor leaves its Fatneſs behind [w]; thro' Sand, its Saltneſs [x], *&c.*

Inſtances in Gums and Gems.

6. The clear *Gum* of Trees, is but a certain Juice of the Tree, finely ſtrained thro' the Wood and Bark. In like manner, *Corniſh-Diamonds*, and Rock-Rubies, are the fine Exudations of Stone.

The Feathers of Birds.

7. The Feathers of Birds are of more lively Colours, than the Hairs of Beaſt; for no Beaſt has any fine Azure, or Carnation Hair. *Ariſtotle* gives this Reaſon for it; that Birds are more in the Sun, than Beaſts; which is manifeſtly falſe: for Cattle are more in the Sun than Birds, that commonly live in covert. The true *Cauſe* may be, that the excrementitious Moiſture of living Creatures, which makes as well the Feathers in Birds, as the Hair in Beaſts, paſſes in Birds thro' a more delicate Strainer, than in Beaſts: for *Feathers* paſs thro' *Quills*; and *Hair*, thro' *Skin*.

Clarification an inward Percolation.

8. The clarifying of Liquors by Adheſion, is an inward Percolation [y], and effected, when ſome cleaving Body is mixed and agitated with Liquors; whereby the groſſer part ſticks to that cleaving Body: whence the finer are freed from the groſſer. So the Apothecaries clarify their Syrups by whites of Eggs; which gather all the dregs, and groſſer parts of the Juices to them: and the Syrup being ſet on the fire, the Whites themſelves harden, and are taken off,

ſeem deficient in point of commodiouſneſs and practicability. If the Thing be greatly wanted, Men might perhaps do well to have their Eyes upon *artificial Congelation*; and the ways of procuring it any any Time of the Year.

[t] See the *Novum Organum*, Part II. Sect. I.

[u] Has this Salt been obtained, from *all Earths*, by waſhing, boiling, and the common Proceſs for Cryſtallization?

[v] Theſe Particulars deſerve to be attentively conſider'd; to ſhew their juſtneſs, and lead to farther Diſcoveries, with relation to the *ſweetning of Sea-Water*; and other Operations.

[w] Thus in Diſtilling from *Malt-Waſh*, as they call it, a thick woollen Strainer ſeparates a large quantity of fulſome unctuous Matter, that would otherwiſe render the Spirit nauſeous and fetid.

[x] As mention'd above, § 2, 3, 4.

[y] Where the Strainer paſſes thro' the Body of the Liquor, carrying down the groſſer Parts along with it, as in a Net.

off. So *Ippocraſs* is clarified by mixing it with *Milk*; ſtirring it about, and then paſſing it thro' a woollen Bag: the cleaving Nature of the *Milk*, drawing the Powder of the Spices, and groſſer Parts of the Liquor to it; ſo that in the Paſſage they ſtick to the woollen Bag.

9. The clarifying of Water, is an Experiment tending to Health; beſides the Pleaſure of the Eye, when Water appears Cryſtalline. This is effected by placing Pebbles at the Head of the Current; that the Water may ſtrain thro' them [z]. *Water clarified.*

10. Perhaps, *Percolation* not only cauſes Clearneſs and Splendour, but alſo Sweetneſs of Odour; for this follows as well as Clearneſs, when the finer Parts are ſeparated from the groſſer. So the Sweat of Men, who have much Heat, much Exerciſe, clean Bodies, and fine Skins, ſmells ſweet; as was ſaid of *Alexander:* and we commonly find that Gums are odoriferous [a]. See the *Articles*, CLARIFICATION, DRINKS, SALT-WATER, and SEPARATION. *That Percolation may make Bodies odoriferous, as well as clear.*

PILOSITY.

Beaſts are more *hairy* than Men, and Savages more than the civilized: but the *Plumage* of Birds exceeds the *Piloſity* of Beaſts. The *Cauſe* of greater ſmoothneſs in Men is not any great Heat and Moiſture, tho that indeed may occaſion *Piloſity*; but there is requiſite to *Piloſity*, not direct Heat and Moiſture, ſo much as *excrementitious Heat and Moiſture:* for whatever aſſimilates, goes not into the Hair: and excrementitious Moiſture abounds moſt in Beaſts, and Savages. The *Plumage* of Birds has much the ſame *Cauſe*; for Birds aſſimilate leſs, and diſcharge more than Beaſts: their Excrements being liquid, and their Fleſh generally more dry. Beſides, they have no *Organs of Urine*; ſo that all their excrementitious Moiſture goes into the Feathers: whence 'tis no wonder, Birds ſhould commonly be better Meat than Beaſts, becauſe their Fleſh aſſimilates finer, and ſecretes more ſubtilly. Again, the Head of a Man is hairy at his Birth; which no other Part of the Body is. The *Cauſe* may be want of *Perſpiration*; for much of the matter of Hair, in other Parts of the Body, goes off by INSENSIBLE PERSPIRATION. Beſides, the *Skull* being of a more ſolid Subſtance, nouriſhes and aſſimilates leſs, and excerns more; ſo likewiſe does the *Skin*. We ſee alſo, that Hair comes not upon the Palms of the Hands, nor the Soles of the Feet; which are Parts more perſpirable: and Children are not hairy; becauſe their Skins are more perſpirable [b]. *The Cauſe of Piloſity and Plumage.*

PLAGUE.

[z] 'Tis common in *Italy* and *Holland* to uſe *filtring Stones*, cut into a kind of Mortars, for clarifying Water; and ſome have them alſo in *England*. See the *Article* CLARIFICATION.

[a] This Obſervation might be alſo extended to *Taſtes:* thus *Wines*, &c. taſte much finer for being clarified. And whoever ſhall proſecute this Enquiry of *Percolation*, in a variety of Subjects, may doubtleſs diſcover many conſiderable Things with regard to Refinements. Thus in particular, the Refinement of *Borax*, which has proved a very gainful Buſineſs to ſome, depends upon a proper *Percolation*. So does the refining of *Sugar*, *Manna*, *Tartar*, and numerous *Drugs*.

[b] This Article has relation to a *Phyſical Anatomy*, which ſeems ſcarce hitherto begun; I mean the Inveſtigation of the *phyſical Cauſes of the Phænomena of Animal Bodies*. For the *Cauſes* hitherto aſſigned in *Anatomy* are rather *Final* than *Phyſical*; and have a greater regard to

PLAGUE.

Prognosticks of the Plague *from Vermin.*

1. During the late Plague, there were found in several Ditches, and low Grounds about *London*, many Toads, that had Tails, two or three Inches long; whereas Toads usually have no Tails at all. This shew'd a great disposition in the Soil and Air, to Putrefaction. 'Tis reported likewise, that *Roots*, as *Carrots* and *Parsnips*, are more sweet and luscious in infectious Years than ordinary [c].

Insects, &c.

2. Those Years have been noted for pestilential, and unwholesome, wherein there were great Numbers of *Frogs*, *Flies*, *Locusts*, &c. For these Creatures being engender'd of Putrefaction; an abundance of them shew a general Disposition of the Year, and Constitution of the Air, to Diseases, that proceed from *Putrefaction* [d].

How Odours affect in the Plague.

3. The *Plague* is often *said* to be catched without any manifest Indication; and *they report*, where 'tis found, that it has the scent of a *mellow Apple*, or of *May-Flowers*. 'Tis also received, that the smell of Flowers, ripe and luscious, are bad in the Plague; such as white *Lillies*, *Cowslips*, and *Hyacinths*.

Antidotes preventive of the Plague.

4. The Plague is not easily received by those that continually attend the Sick; as Physicians, *&c.* nor by such as take Antidotes; *viz.* *Mithridate*, *Juniper-berries*, *Rue*; or hold in the Mouth, *Angelica*, *Zeodary*, &c. or use *Tar*, *Galbanum*, and the like, in Perfumes; nor again by old People, and such as are of a dry and cold Complexion. On the other hand; the *Plague* soonest seizes those that come out of the fresh Air; those that are fasting; and Children. 'Tis likewise noted to go in a Blood, more than from Stranger to Stranger [e].

POISONS.

The Infection of Prisons.

1. The most pernicious *Infection*, next the *Plague*, is that of a Jail; where Prisoners have been long kept close, and unwholesome. Of this we have had Experience, twice or thrice, in my time; when the Judges, and many of the Attendants, sicken'd upon it, and died. It were therefore prudent in such Cases to air the Prison, before the Prisoners are brought out.

How to be imitated.

2. If such destructive Smells may be made by Art, they must, probably, consist chiefly of *Man's Flesh*, or *putrefied Sweat* [f]; for those ill Odours which

to the remote *Wisdom*, and *Contrivance*, shewn in the Structure of the Parts, than the direct, and immediate manner of their Formation; or the true Process and Operation of Nature used therein.

[c] The same has been said of Fruits, as *Cherries*, &c. and it is usual in *infectious Seasons*, for the Multitude to accuse some one Thing or other; but with what justness is not so certain.

[d] Does the *Plague* proceed from direct *Putrefaction*; or some more latent *Cause?* To determine this, so as to from *Axioms*, and sure *Rules* of *Practice*, requires a rigid Enquiry; which seems hitherto scarce attempted. For they are generally but *crude Observations*, *jejune Experiments*, and *superficial Notions*, that have been published upon this Subject.

[e] These Particulars seem remarkably confirm'd by *Diemerbroeck*'s Account of the *Plague* at *Nimwegen*. See also Mr. *Boyle*'s *Treatise of Effluvia*; and the *Articles* AIR *and* POISONS.

[f] What certainty is there in these Conjectures? It is indeed said to this Day, that the most destructive Poisons of the *Indians* are prepared from Man's Flesh; which, to have any such

which the Noſtrils immediately abhor and expel, are not the moſt pernicious; but ſuch as have ſome ſimilitude with the Body; ſo that they imperceptibly inſinuate themſelves, and betray the Spirits.

Their ill Effects how prevented.

3. There may be great danger in uſing ſuch *Compoſitions* at large Meetings of People, within Doors; as in Churches, at Arraignments, at Plays, Solemnities, and the like: for poiſoning of Air is no leſs dangerous, than poiſoning of Water; which was practiſed by the *Turks* in the Wars; and by *Emmanuel Comnenus* upon the Chriſtians, when they paſs'd thro' his Country to the *Holy Land*. And this *poiſoning of Air* is the more dangerous in Concourſes of People, becauſe their Breath promotes the Reception of the Infection; and therefore when any ſuch thing is ſuſpected, thoſe publick Places ſhould be perfum'd before the Aſſemblies meet.

Poiſoning practiſed in Gloves, *&c.*

4. The *poiſoning* of particular Perſons by Odours, has been practiſed in *perfum'd Gloves*, or the like: and probably they mix the *Poiſon* with ſome ſweet Smells, which alſo make it the ſooner received. *Plagues* too have been raised by anointing the Chinks of Doors, and the like [g]; not ſo much from the Touch, as becauſe 'tis common for Men, when they find any thing wet upon their Fingers, to put them to their Noſe: which one ſhould therefore beware of. The beſt of it is, that theſe *Compoſitions* for infecting the Air, cannot be made without danger of Death to the Makers: But then, they may have Antidotes to preſerve themſelves; ſo that Men ought not to be too ſecure.

The venomous quality of Man's Fleſh.

5. The *French report*, that at the Siege of *Naples*, there were certain wicked Merchants, who barrell'd up Man's Fleſh, and ſold it for *Tunny*; which proved the Cauſe of the *Venereal Diſeaſe* [h]. And it is certain, that the *Canibals* in the *Weſt Indies*, eat Man's Fleſh; and the *Weſt Indies*, when firſt diſcover'd, were over-run with this Diſtemper: and the moſt *mortal Poiſons*, practiſed by them, have ſome mixture of the Blood, or Fat, or Fleſh of Man [i].

The Plague, and poiſonous Effects, from Effluvia.

6. Great *Plagues* have ariſen, in ſeveral Countries, from the Putrefaction of great ſwarms of dead Graſshoppers and Locuſts, thrown in Heaps. And *Damps* frequently happen in *Mines*; which kill either by Suffocation, or the poiſonous Nature of the Mineral: and thoſe who deal in *refining*, or other Works about Metals and Minerals, have their Brain hurt and ſtupefied, by the metallic Vapours. And 'tis obſervable, that *Quickſilver* flies to the Skull, Teeth, or Bones; inſomuch, that Gilders uſually hold a piece of Gold in their Mouths, to attract the Quickſilver: and this Gold they afterwards find to

Effect, muſt probably be putrefied; and uſed in the height of the Putrefaction. We know that *putrefied Eggs*, and *animal Juices*, have a poiſonous Quality; and might, perhaps, prove mortal, barely by the Smell. See the *Proceſſes upon Animals*, in *Boerhaave*'s *Chemiſtry*. See alſo below, § 5.

[g] I ſuppoſe this is meant of anointing them with the matter of the Plague-Sores, or other corrupt and excrementitious Parts of a Body infected.

[h] The true Cauſe of this Diſtemper ſeems ſtill uncertain; after all the Enquiry that has been made after it. The principal Reaſon of the uncertainty ſeems to be, that every Enquirer carries his own *Idol*, or ſome preconceived Notion, along with him; to which he wreſts all the Facts and Phænomena.

[i] See the Note upon § 2. above.

to be whiten'd. There are alſo certain Lakes and Pits, as that of *Avernus*, which poiſon the Birds that fly over them; or Men that ſtay too long near them.

The vapour of burning of Coals poiſonous.

7. The Vapour of Char-coal, or Sea-coal, in a cloſe Room, has kill'd many: and is the more dangerous, becauſe unattended with any ill Smell, but ſteals on by degrees; inducing only a Faintneſs. When the *Dutchmen* winter'd in *Nova Zembla*, and could gather no more Sticks, they made a Fire of ſome Sea-Coal they had; wherewith at firſt they were much refreſh'd: but ſoon after, there grew a general Silence, and Indiſpoſition to ſpeak, among them; when immediately one of the Company fainted; whereupon ſuſpecting what it was, they open'd their Door to let in the Air: and thus ſaved themſelves. The effect ſeems wrought by the Inſpiſſation of the Air; and ſo of the Breath and Spirits. The like happens in Rooms, newly plaiſter'd, if a Fire be made in them; by which means the Emperor *Jovinianus* loſt his Life [k].

POSTURES.

The beſt Poſtures of the Body for prolonging Life.

1. Lying, not upright, but hollow, from the make of the Bed; or with the Legs gather'd up, from the Poſture of the Body, is the more wholeſome; becauſe thus the Stomach is better aſſiſted; as being leſs penſile: and we ſee, that in weak Stomachs, 'tis uſeful to lay the Legs high, and the Knees almoſt to the Mouth. So Galley-ſlaves, notwithſtanding their Miſery otherwiſe, are commonly fat and fleſhy; becauſe the Stomach is ſomewhat ſupported in ſitting: but is penſile in ſtanding or going. Therefore to prolong Life, 'tis proper to chuſe thoſe Exerciſes wherein the Limbs move more than the Stomach and Belly; as in rowing [l], *&c.*

2. *Megrims* and *Giddineſs* happen rather upon riſing after long ſitting, than while one ſits; becauſe the Vapours, which were gather'd by ſitting, fly more into the Head, upon ſudden Motion.

3. Leaning long upon any Part makes it numb, and, as we call it, *aſleep:* becauſe the Compreſſion of the Part, ſuffers not the Spirits to have acceſs; and therefore, as the part comes out of this Numbneſs, we feel a pricking, which may be cauſed by the re-entrance of the Spirits [m].

PRESERVATION.

Bodies preſerved in Quickſilver.

1. Tie a Stock-gilly-flower gently upon a Stick, and put it into a Glaſs of Quickſilver; ſo that the Flower may be cover'd: then lay a little weight upon the top of the Glaſs, to keep the Stick down; and after four or five Days, you ſhall find the Flower freſh, and the Stalk harder, or leſs flexible, than it was. By comparing this with another Flower, gather'd at the ſame time, the Fact will be more manifeſt. Whence it appears, that Bodies may be excellently preſerved in Quickſilver; and not only preſerved, but alſo indurated

[k] This Death is ſaid to have befaln many others; upon entering Rooms that were kept cloſe whilſt the Fire was burning to air them. For Air becomes poiſonous by paſſing thro' Fire; as is now commonly known, from the *Air-Pump*; tho the *Cauſe* is not ſatisfactorily diſcover'd.

[l] See the Author's *Hiſtory of Life and Death.*

[m] This Subject may deſerve an accurate *Enquiry.*

indurated by the coldneſs of the Quickſilver: for tho the freſhneſs of the Flower may be merely owing to *Conſervation*; yet the ſtiffneſs of the Stalk, is owing to induration, from the coldneſs, as it ſhould ſeem, of the Quick-ſilver [n].

The preſervation of Liquors in Wells and Vaults.

2. Earthen Bottles fill'd with different *Liquors*, and well ſtopped, were hung in a Well of twenty Fathom deep: and ſome Bottles were let down into the Water; whilſt others were ſuſpended within about a Fathom of its ſurface. The *Liquors* were *Beer*, *Wine*, and *Milk*. The *Beer* and the *Wine*, as well within the Water as above it, were not palled or deaden'd at all; but ſomewhat better than Bottles of the ſame Liquor kept in a Cellar; tho ſuch as hung above the Water were apparently the beſt: and the Beer thus treated flower'd a little; whereas that under Water did not; tho it was freſh. The Milk ſoured, and began to putrefy. Yet there is a Village near *Blois*, where, in deep Caves, they thicken *Milk*; ſo that it becomes very pleaſant: which was one Reaſon of our Trial, tho it did not ſucceed. Perhaps the *Milk*, expoſed in thoſe Caves is firſt boiled: it were proper therefore to try it, with *boil'd Milk*, and with *Cream*: for *Milk* is ſuch a compound Body of *Cream*, *Curds* and *Whey*, that it uſually turns and diſſolves [o].

Experiment for the Preſervation of Roſe-leaves, &c.

3. Pluck *Damask-Roſes*, and dry them upon a *Lead*, or *Terras*, in the hot Sun; between the Hours of twelve and two. Then put them into a ſweet, dry Glaſs, with a narrow Mouth; preſſing them cloſe together; but without bruiſing: ſtop the Glaſs tight; and the *Roſes* will thus retain, not only their Smell in Perfection, but likewiſe their Colour freſh; for a Year, at leaſt. Note, that nothing deſtroys any Plant, or other Body ſo much, whether by *Putrefaction* or *Arefaction*, as the adventitious Moiſture, that hangs looſe in the Body, unleſs drawn out: for this Moiſture carries away the *radical Moiſture*, when itſelf goes off [p]. Whence alſo in living Creatures, moderate Sweat preſerves the Juices of the Body [q]. Note, that the *Roſes*, when fully dried, as abovementioned, have little or no Smell; ſo that their Odour here is a ſecondary Odour, that iſſues from the Flower afterwards.

Prevention of Putrefaction, and the Conſervation of Bodies.

4. 'Tis ſtrange, and deſerves a careful Obſervation, how long *Cartaſſes* may continue uncorrupted, and in their own Dimenſions; as in the Mummies of *Egypt*: which have ſome of them laſted, as is conceived, three thouſand Years. 'Tis true, they take out the Brains, and Entrails, which are the Parts apteſt to corrupt: but the Fleſh itſelf is a ſoft corruptible Sub-

[n] This Experiment ſhould by all means be repeated, varied, and extended to other Bodies. See the *Article* ANNIHILATION.

[o] We noted above, under the *Article* MILK, that the *Hiſtory of the Dairy* was greatly wanting; and ſhall here add, that the Author has given ſeveral excellent Hints relating to it; more, perhaps, than any one would expect, who has ſo attentively conſider'd the Subject, as to ſee that it enters deep into *Chemiſtry*, and *Natural Philoſophy*.

[p] This is an *Obſervation* of great Importance in *Natural Philoſophy*; and particularly uſeful to *Chemiſts*, *Apothecaries*, *Druggiſts*, *Perfumers*, &c. whence it might deſerve to be explained, illuſtrated, and verified, by a large *Induction*.

[q] This alſo deſerves to be explained along with the reſt; and, indeed, the former *Obſervation* is ſo general, as to reach the Bodies of all the three Kingdoms.

ſtance. It ſhould ſeem, that *Putrefaction*, which we conceive to be ſo natural a period of Bodies, *is but an Accident*; and that Matter haſtens not ſo faſt to Corruption as is ſuppoſed. Whence Bodies included in Amber, Quickſilver, *Balſams*, *Wax*, *Honey*, *Gums*, and perhaps in Conſervatories of Snow, *&c.* are very long preſerved.

The Cauſes of Putrefaction, how to be ſuſpended.

5. If we provide againſt the three following *Cauſes of Putrefaction*, Bodies will not corrupt °: the *firſt* is, that *the Air be excluded*; for Air undermines the Body, and conſpires with its Spirit to diſſolve it. The *ſecond* is, that the *adjacent Body be heterogeneous* to that deſigned to be preſerved; for if nothing can be received by the one, nothing can iſſue from the other: ſuch Bodies are *Quickſilver*, and *Amber*, with regard to *Herbs*, *Flies*, &c. The *third* is, that the Body to be preſerved, be not ſo groſs as to corrupt within itſelf, tho no part of it iſſue into the adjacent Body; and therefore it muſt be rather thin and ſmall, than bulky P.

When the Body to be preſerved is large.

6. There is alſo a *fourth* Remedy, if the Body to be preſerved is a thing of bulk; as a *Corps*, &c. for then, the incloſing Body muſt have a Virtue to draw forth, and dry up, the Moiſture of the inward one; elſe the Putrefaction will play within, tho nothing iſſue out. *Livy* relates, that there were found at the ſame time, two Lead-coffins in a Tomb; one that contained the Body of King *Numa*; and the other, his Books of *ſacred Rites*, *Ceremonies*, and the *Diſcipline of the Pontifs*: and that in the firſt Coffin, where the Body had lain four hundred Years, there was nothing to be ſeen, but a little Cinders about the Sides; whilſt, in the other, the Books were found as freſh as if they had been newly written; being of Parchment, and covered over with Wax-candles three or four doubles. By this it ſhould ſeem, that the *Romans* in *Numa*'s Time, were not ſo good Embalmers as the *Egyptians*; becauſe the Body was utterly conſumed. But *Plutarch*, and others, relate that when *Auguſtus Cæſar* viſited the Sepulchre of *Alexander the Great*, in *Alexandria*; he found the Corps to keep its Dimenſions: and tho the Embalming was, doubtleſs, the beſt for that Time; yet the Body was ſo tender, that *Cæſar* touching but the Noſe thereof, defaced it. Which makes it appear ſtrange, that the *Egyptian Mummies* ſhould be reported as hard as Stone-pitch: but, probably, the ancient *Egyptian* Mummies were ſhrouded in many Folds of Linen, beſmeared with Gums, in the manner of *Sear-cloth*; which, it does not appear was practiſed upon the Body of *Alexander* q. See the *Article* PUTREFACTION, and the *Preſervation of Fruit* under the *Article* VEGETABLES.

PRIN-

° It cannot well be too often inculcated, that *to know the Cauſes of Things, is obtaining Directions for ſtopping, or over-ruling them*; as alſo for employing them as *Agents* in producing Effects. See the *Novum Organum*, Part II. Sect. I.

P This Enquiry is one of the moſt capital in all Phyſicks; Putrefaction being the *Medium* of the grand Changes in Material Things; and the Maſter-key of the principal Operations, both of *Nature* and *Art*. On which account it ſhould be earneſtly recommended to all thoſe who are concerned for the Improvement of *Natural Knowledge*, and the Production of CAPITAL WORKS.

q The Art of *Embalming*, whatever it may have been anciently among the *Egyptians*, is far from the degree of Perfection in *Europe*, which, in all Probability, it might arrive at. But as its

PRINCIPLES OF CHEMISTRY.

1. There are two great *Families of Things*, called by the Chemiſts, *ſulphureous* and *mercurial*, whereof their third *Principle*, *Salt*, is but a Compoſition [r]. We may otherwiſe call theſe Families of Things, *inflammable* and *uninflammable*, or *mature* and *crude*, or *oily* and *watery*. Thus, Brimſtone and Quickſilver abound in the ſubterraneous Regions, as the Fathers of their Tribes; Oil and Water, in the *vegetable* and *animal* Kingdoms; Air and Flame, in the lower pneumatical Regions; and pure Æther and Light, in the celeſtial Spaces. And theſe Pairs of Things, tho unlike in the primitive Differences of Matter, yet ſeem to have many Agreements. *Mercury* and *Sulphur* are the principal Materials of *Metals*: *Water* and *Oil* are the principal Materials of *Vegetables* and *Animals*; and ſeem to differ but in Maturation or Concoction. In ſhort, theſe two Tribes of Things ſeem vaſtly extenſive; ſo as to occupy and enter the whole material World. 'Tis therefore one of the greateſt *Magnalia Naturæ*, to turn *Water* into *Oil*; greater in *Nature*, than to turn *Silver* or *Quickſilver* into *Gold* [s]. *Obſervations upon the two chemical Principles*, Sulphur *and* Mercury.

2. There are four kinds of *Inſtances*, wherein crude and watry Subſtances turn into ſuch as are fat and oily; *viz.* Firſt, in the *Mixture of Earth* and *Water*; which, by the help of the Sun, acquire a *nitrous Fatneſs*, more than either of them has ſeverally; for thus they put forth Plants, which require both oily and aqueous Juices [t]. The *ſecond* is the *Aſſimilation of Nouriſhment, in the Bodies of Plants and Animals*; for Plants turn the Juices of mere Earth and Water, into much oily Matter [v]. Animals, tho great part of their Fat and Fleſh proceed from oily Aliment, yet aſſimilate alſo, in ſome meaſure, the Water they drink. But theſe two Ways of converting *Water into Oil*, by Mixture and Aſſimilation, require many Percolations, a long Continuance of a ſoft Heat, and ſeveral Circulations. The *third* is, in the beginning of *Putrefaction*; as in *Water* corrupted, and the Mothers of diſtilled Waters; both which have a kind of Fatneſs, or Oil [u]. The *fourth* is, the *Edulcoration of ſome Metals*, or rendering of them Saccharine; as in *Saccharum Saturni* [w], &c. *Inſtances of Water turned into Oil.*

its Perfection principally depends upon a juſt *philoſophical Chemiſtry*, it may require ſome Ages yet, to advance it to its height: for *philoſophical Chemiſtry* has but of late began to appear in *Europe*. It may be worth enquiring, whether ſuch Improvements could not be made in the vulgar *Art of Tanning*, as might render it capable of preſerving *dead Bodies* in great Perfection.

[r] See M. *Homberg's Eſſays* upon the *Chemical Principles*, in the *French Memoirs*, paſſim.

[s] This is to be underſtood not of any Separation, but of an *actual Tranſmutation*; ſo that the Matter which had the full Form and Properties of *Water* before, has now the full Form and Properties of *Oil*. See the *Articles* ALTERATIONS, and TRANSMUTATION.

[t] See Mr. *Boyle's Sceptical Chemiſt*; and Dr. *Woodward's Experiments* upon the Growth of Vegetables, in the *Philoſophical Tranſactions*.

[v] But, it may be ſuſpected, that the unctuous Matter is formed in the *Plant*: Experiment muſt determine this.

[u] Here lies a conſiderable Secret. See *Boerhaave's Chemiſtry*; on the Method of converting *Vegetable* into *Animal* Matters, by Means of *Putrefaction*. Proceſs 77.

[w] Here is another conſiderable Secret: for *Saccharum Saturni* yields an *inflammable Spirit* by Diſtillation.

The Means of converting Water into Oil.

3. The Converſion of Water into a more oily Subſtance, is promoted by *Digeſtion*; for Oil is little more than Water digeſted: and this Digeſtion is principally carried on by Heat; which Heat muſt be either outward or inward. Again, this Digeſtion may be forwarded by *Provocation*, or *Excitation*; which is cauſed by the Admixture of Bodies already oily or digeſted: for theſe will ſomewhat communicate their Nature to the others. *Digeſtion* alſo is ſtrongly performed by the direct *Aſſimilation of crude Bodies, into Bodies digeſted*; as in *Plants* and *Animals*, whoſe Nouriſhment is far more crude than their Bodies: but this Digeſtion requires, as was before obſerved, a length of Time, and many Circulations [x]. See the *Articles*, ALTERATIONS and TRANSMUTATION.

PUTREFACTION.

An Enquiry into the Means of introducing, and accelerating Putrefaction.

1. The introducing and accelerating of *Putrefaction*, is an extenſive Subject; for *Corruption* is reciprocal to *Generation:* and theſe two are as Nature's Limits, or Boundaries; and the Conductors to *Life* and *Death* [y].

The Cauſes of Putrefaction.

2. All *Putrefactions* proceed, chiefly, from the internal *Spirits* of the Body; and partly from the *Ambient*, be it Air, Liquor, or any thing elſe. The latter Cauſe takes place by two Means; *viz.* either by the Entrance of the Subſtance of the ſurrounding Body into the putrefied Body; or elſe by the Excitation and Sollicitation of the putrefied Body, and the Parts thereof, by the ſurrounding Body. As for the received Opinion, that *Putrefaction* proceeds either from Cold, or preternatural Heat, 'tis trifling: for Cold, in Things inanimate, is the greateſt Enemy to *Putrefaction*; tho it extinguiſhes Vivification, which always conſiſts in attenuated Spirits, that congeal and coagulate with Cold. But as for *preternatural Heat*, 'tis ſo far true, that if the Proportion of adventitious Heat greatly predominate over the natural Heat, and the Spirits of the Body; it tends to Diſſolution, or a conſiderable Alteration: but this is wrought by *Emiſſion*, or *Suppreſſion*, or *Suffocation*, of the *native Spirits*; and alſo, by the *Diſcompoſure of the tangible Parts*, and other Paſſages of Nature; and not by a Conflict of Heats.

3. *Pu-*

[x] The Author intended a ſevere Enquiry into the *three* Chemical Principles, *Salt*, *Sulphur*, and *Mercury*. He has left us the *Introduction* deſigned for it; which contains little more than what is delivered under the preſent *Article*. Himſelf calls it one of the *profoundeſt Enquiries of Nature*; and brings under it, the Heads of *Converſion*, or the *Tranſmutations of Bodies*, and the *primary Collections*, or *original Congregations of Matter*; which, like a general Aſſembly of a State, give Laws to all Bodies. And tho he makes the Principle *Salt* no more than a Combination of *Sulphur* and *Mercury*, held together by a ſharp Spirit; yet he thought proper to admit it in his Enquiry: not only on account of its relation to *Sulphur* and *Mercury*; but becauſe of its extreme Utility, as being the common Link of the *ſulphureous* and *mercurial Nature*, and the *Rudiment of Life* itſelf. In this *Enquiry*, had he proſecuted it, he propoſed to have continued the Uſe of the Expreſſions, tho he generally rejected the Opinions of the Chemiſts, as unſound. We may reaſonably expect it would have been a grand and ſerviceable Enquiry: but he left it for Poſterity to finiſh. Mr. *Boyle*, Sign. *Guglielmini*, M. *Homberg*, and Dr. *Stahl*, have all contributed to it.

[y] We have here the beginning of a regular *Enquiry* into *Putrefaction*; with a ſteddy Eye upon the Proceſſes of Nature.

3. *Putrefaction*, therefore, *is the Work of the Spirits of Bodies*; which are ever attempting to get forth, and congregate with the Air, and enjoy the Sun-beams. The Eſcape, and ſpreading of the Spirits, which is a degree of Eſcape, appears in *five* different Operations: (1.) If the Spirits are detained within the Body, and move violently, there follows *Colliquation*, or Melting; as in Metals, *&c.* (2.) If they move mildly, there enſues *Digeſtion*, or *Maturation*; as in *Drinks* and *Fruits*. (3.) If the Spirits be not merely detained, but protude a little, and the Motion be confuſed and inordinate, then follows *Putrefaction*; which always diſſolves the conſiſtence of the Body with great Inequality: as we ſee in putrefied Fleſh, rotten Fruits, ſhining Wood, *&c.* and alſo, in the Ruſt of Metals. (4.) But if that Motion be in a certain Order, there follow Vivification, and Figuration; as in living Creatures, bred from *Putrefaction*; and in perfect Animals. (5.) But if the Spirits iſſue out of the Body; then follow *Deſiccation*, *Induration*, *Conſumption*, *Evaporation*, &c. *Five Operations of the Spirits of Bodies, in order to eſcape.*

4. The Means of inducing and accelerating Putrefaction are, (1.) by the *Addition of crude or watry Moiſture*; as in the Wetting of Fleſh, Fruit, Wood, with Water, *&c.* for, otherwiſe, unctuous and oily Subſtances preſerve themſelves. (2.) By *Invitation*, or *Excitation*; as when a rotten Apple lies cloſe to another that is ſound: or when Dung, a Subſtance already putrefied, is added to other Bodies. This alſo appears remarkably in *Church-yards*; where the Earth conſumes a Corps in much ſhorter time than other Earth will. (3.) By *Cloſenſs*, and *Suppreſſion*; which detains the Spirits in Priſon, and thereby irritates them to ſeek iſſue; as in *Corn*, and *Clothes*, which grow muſty; but are preſerved freſh by the open Air: and this appears more evidently in Agues, which generally proceed from *Obſtructions*, and the penning up of the Humours, which thereupon putrefy [z]. (4.) By *Solution of Continuity*: thus, an Apple will rot the ſooner for being cut or pierced; ſo will Wood; and the Fleſh of Animals, where they have received any Wound. (5.) By *exhaling or driving back the principal Spirits*, which preſerve the Conſiſtence of the Body; ſo that when their Government is diſſolved, every Part returns to its Nature. This appears in Urine and Blood, when they cool; and thereby break: as alſo in Gangrenes, or Mortifications of the Fleſh, either by Opiates or intenſe Cold. I conceive, alſo, the ſame Effect in Peſtilences; when the Malignity of the infecting Vapour diſturbs the *principal Spirits*, and makes them fly, and leave their Government; whence the Humours, Fleſh, and *ſecondary Spirits*, diſſolve and break, as in an Anarchy [a]. (6.) By *the entring of a foreign Spirit*, ſtronger, and *Ten practical Ways of introducing* Putrefaction.

[z] Were it not proper to range and claſs *Putrefactions* into different kinds, that the Enquiry might proceed with greater clearneſs and exactneſs? *Vegetable*, *Animal*, and *Mineral Putrefactions* are very comprehenſive Heads, that allow of numerous Subdiviſions in this Enquiry. Thus there is one Putrefaction of *Wines*, another of *Vinegars*; one of *Milk*, another of *Blood*; one of *Vitriol*, another of *Nitre*, &c. that may be accounted ſo many Species of Putrefaction.

[a] Theſe Expreſſions, tho metaphorical, ſeem aptly, ſtrongly, and ſcientifically, to expreſs the Nature of the Thing. And till a *philoſophical Language* be introduced, perhaps, it is impoſſible to deſcribe the internal Natures of Things, without ſome degree of *Metaphor*.

and more eager than the Spirit of the Body; as in the Bite of the Viper. And this is, generally, the Cauſe that ſwelling enſues upon all Poiſons: which follows, alſo, when the Spirits of the Body congregate too much; as upon Blows, and Bruiſes; or when they are pent in too much, as in Swellings upon Cold. And the Spirits proceeding from the Putrefaction of Humours in Agues, *&c.* tho bred within the Body, yet extinguiſh and ſuffocate the *natural Spirits* and Heat. (7.) By *ſuch a weak degree of Heat as ſets the Spirits in a ſmall degree of Motion*, but is not able either to diſcharge them, or digeſt the Parts; as in Fleſh kept in a warm Room; which, in a cool Larder would keep longer: and we ſee that Vivification is effected by ſuch ſoft Heats as theſe; for Example, in the hatching of Eggs; the heat of the Womb, *&c.* (8.) By *releaſing the Spirits*, which before were cloſe confined by the Solidity of their Cover, whereby their Appetite of iſſuing was checked; as in artificial Ruſts, induced by Menſtruums, upon *Iron*, *Lead*, &c. and hence Wetting haſtens Ruſt or *Putrefaction*, becauſe it ſoftens the Cruſt for the Spirit to come forth. (9.) By the *Interchanges of Heat and Cold*, or *wet and dry:* as we ſee in the mouldering of Earth expoſed to Froſts and the Sun; and in the more haſty rotting of Wood, that is ſometimes wet, and ſometimes dry. (10.) By *Time*, and the *Operation*, or *Proceſs* of the *Spirits*; which cannot keep their Station, eſpecially if left to themſelves; and there be no Agitation or local Motion: as we ſee in Corn not ſtirred; and Men's Bodies that are not exerciſed. All *Mouldineſs* is the beginning of *Putrefaction*; as the Mouldineſs of Meats, Oranges, Lemmons, *&c.* which Mouldineſs, afterwards, breeds Worms, or more odious Putrefactions; and therefore, commonly proves of an ill Odour. Or if the Body be liquid, and not apt to putrefy totally, it will caſt up a Mother on the top, like the Mother of diſtilled Waters [b].

Ten Means of preventing Putrefaction.

5. 'Tis of great Uſe, to enquire into the Means of preventing *Putrefaction*; as therein conſiſt the *Means of preſerving Bodies:* for Bodies have two kinds of Diſſolution; the one, by *Conſumption* and *Deſiccation*; the other, by *Putrefaction* [c].

6. The *firſt* Means of prohibiting Putrefaction, is *Cold:* for we ſee, that Meat and Drink will laſt longer unputrefied in Winter, than in Summer; and Flowers and Fruits, put in *Conſervatories of Snow*, keep freſh. This *Cauſe* operates by *Detention of the Spirits*, and *Conſtipation of the tangible Parts.*

7. The *ſecond Means*, is *Aſtriction:* for Aſtriction prevents Diſſolution; as we generally ſee in Medicines; whereof ſuch as are Aſtringent, reſiſt Putrefaction: and, for the ſame Reaſon, a ſmall Quantity of *Oil of Vitriol will*

[b] This Subject of *Putrefaction*, tho ſo important in itſelf, ſeems to have been greatly neglected by Philoſophers. Some few Hints are given us of it by Mr. *Boyle*, and Sir *Iſaac Newton*; but Dr. *Stahl* appears to have carefully obſerved this *grand Proceſs of Nature*, ſo as to continue the ſtrict Enquiry here begun by the Author.

[c] Theſe *larger Obſervations*, as the Author uſually calls them, ought to be well attended to, by all who deſire to continue his Enquiries.

will long preſerve freſh Water from putrefying [d]. And this Aſtriction is found in a Subſtance that has a virtual Cold; and works, partly, by the ſame Means as Cold.

8. The *third* is, *Excluſion of the Air*; and again, *expoſing to the Air*: for theſe Contraries work the ſame Effect; according to the Nature of the Subject-matter. So we ſee that Beer, or Wine, in Bottles cloſe ſtopped, laſts long; that the *Garners* under ground, keep Corn longer than thoſe above [e]; that Fruit cloſed in Wax, keeps freſh; as likewiſe Bodies put into Honey, or Flower; and Liquors, Drinks and Juices, with a little Oil on the top: as, on the contrary, Cloth and Apparel, not aired, breed Moths and Mould. The *Cauſe* of the Difference is, that in Bodies requiring Detention of Spirits, the Excluſion of the Air doth good; as in Drinks, and Corn: but in Bodies that require Emiſſion of the Spirits, to diſcharge ſome of the ſuperfluous Moiſture, it doth hurt: for theſe require airing.

9. The *fourth Means*, is *Motion*, and *Stirring*; for Putrefaction requires Reſt; its ſubtile Motion being diſturbed by any Agitation: and all local Motion keeps Bodies entire, and their Parts together. Thus, the turning of Corn in a *Garner*, or letting it run like an Hour-glaſs, from an Upper-room into a lower, keeps it ſweet: running Waters do not putrefy: and in the Body, Exerciſe hinders *Putrefaction*; as, on the contrary, *Reſt*, and *want of Motion, promote it.*

10. The *fifth Means*, is the *Breathing forth of adventitious Moiſture, in Bodies:* for, as Wetting haſtens *Putrefaction*; convenient Drying, whereby only the more radical Moiſture is kept in, prevents it: ſo we ſee, that Herbs and Flowers, if dried in the Shade, or in the hot Sun, for a ſhort time, keep better: for, without this Drying, the Emiſſion of the looſe and adventitious Moiſture, betrays the radical Moiſture, and carries that out with itſelf.

11. The *ſixth Means*, is *ſtrengthening the Spirits of Bodies*; for as a great Heat keeps Bodies from Putrefaction, but a tepid Heat inclines them to it; ſo a ſtrong Spirit preſerves from, and a weak or faint Spirit diſpoſes to Corruption. Thus, ſalt Water corrupts not ſo ſoon as freſh: and ſalting of Oyſters, and Meat, keeps them from Putrefaction. It ſhould be alſo tried, whether Chalk does not preſerve Water from putrefying, or Drink from ſpeedy ſouring [f]: ſtrong Beer will laſt longer than ſmall; and all things that are hot, and aromatic, help to preſerve Liquors [g], or Powders, *&c.* which they do as well by ſtrengthening the Spirits, as by ſoaking out the looſe Moiſture.

12. The

[d] This is propoſed by a late Author as a new Diſcovery; and recommended as an effectual Way of preſerving freſh Water at Sea.

[e] Inſomuch that *Corn* is ſaid, by a proper Excluſion of Air and Moiſture, to have been preſerved, under Ground, for forty, fifty, or even a hundred Years.

[f] Chalk ſeems to preſerve Water, in ſome degree; but makes Wine run ſooner into Corruption. Thoſe who will try the Experiment, may here find a conſiderable Secret, with relation to *vinous* and *acetous Fermentation*, and Putrefaction.

[g] Here again, is a conſiderable Secret intimated. Thus, for Inſtance, how ſtrongly ſoever the vulgar Notion may run, that *Brandy is an Enemy to Wine*, as they phraſe it; yet the Cooper

12. The *ſeventh Means*, is a *Separation of the cruder Parts*, which renders the Body more equal: for *all imperfect Mixtures are apt to putrefy*; and *watry Subſtances are more apt to putrefy than oily* [h]. So *diſtilled Waters* will laſt longer than raw Waters; and things that have paſſed the Fire, longer than thoſe that have not paſſed the Fire; as dried Pears, *&c.*

13. The *eighth Means*, is *drawing forth, continually, that Part where the Putrefaction begins*; which is, commonly, the looſe and watry Moiſture: not only becauſe it provokes the *radical Moiſture* [i] to come forth with it; but alſo becauſe, being detained in the Body, the Putrefaction takes hold of it, and thus infects the reſt; as we ſee in the embalming of dead Bodies: and the ſame holds of preſerving Herbs, Fruits, or Flowers, in Bran or Meal.

14. The *ninth Means*, is the *Commixture of things more oily or ſweet*; ſuch being leaſt apt to putrefy, for the Air works little upon them: whence ſuch Bodies, not putrefying themſelves, they preſerve the reſt: thus we ſee *Syrups*, and Ointments, laſt longer than Juices.

15. The *tenth Means*, is the *Commixture of ſomewhat dry*; for *Putrefaction* begins firſt from the *Spirits*, and then from the Moiſture; but dry things are unapt to putrefy: whence Smoke preſerves *Fleſh*; as we ſee in *Bacon*, *Neats Tongues*, &c. The Opinion, that condenſed Air preſerves Bodies longer than other Air, ſeems probable; becauſe condenſed Air being over-charged and compreſſed, will hardly receive, but rather repel the Exhalations of any thing. It was tried in a blown Bladder with Fleſh, and a Flower; but without Succeſs: for dry Bladders will not blow; and new Bladders rather promote Putrefaction. The Way, therefore, is to blow ſtrongly with a Pair of Bellows, into a Veſſel containing what you would have preſerved; and ſtopping the Orifice at the Inſtant the Bellows are withdrawn [k].

R.

RAIN.

Whence the Scarcity of Rain in Egypt.

'TIS ſtrange, that tho the River *Nile* overflows *Egypt*, there ſhould be little or no Rain in that Country. The *Cauſe* is either in the *Nature of the Water*, the *Nature of the Air*, or both. It may be aſcribed to the long Courſe of the Water; for ſwift-running Waters evaporate not ſo much as ſtanding Waters: or to the Concoction of the Water; for Waters well concocted,

Cooper upon the Spot, knows that moſt Wines, and even *Ports*, require to be doſed with Brandy, to fit them for the Market.

[h] Here, again, are two *larger Obſervations*, almoſt fitted for *Axioms*.

[i] If any Objection be made to the Word, *eſſential Moiſture* may be uſed in its ſtead; as in Raiſins, for inſtance, their radical, or eſſential Moiſture, is only the *Saccharine Juice*, and not the *aqueous Part*, wherewith it is mixed in the *Grape*.

[k] This latter part of the Enquiry has been largely proſecuted by *Mr. Boyle*. See his *pneumatical Experiments*, paſſim. But in what we may call the more internal, phyſical, or chemical Part it ſeems to have been almoſt overlooked by the generality of Philoſophers, conſidering the Diſcoveries it might afford.

concocted, evaporate not ſo much as crude Waters: and Water upon the Fire, evaporates not ſo faſt after ſome time boiling, as at firſt. But the Water of the *Nile* is ſweeter than other Water in taſte; and excellent for the Stone, and hypochondriac Melancholy; which ſhews it to be lenifying. It alſo runs thro' a hot and flat Country, without Shade either of Hills or Woods: whence the Sun muſt needs have great Power to concoct it. As for the *Air*; it may be thin and thirſty; ſo as when it receives any Moiſture from the Water, to imbibe and diſſipate it thro' its whole Body, and not ſuffer it to remain in Vapour, ſo as to be the Cauſe of Rain [l]. See the *Article* AIR.

RAINBOW.

Of Sweetneſs of Odour from the Rainbow.

'Tis obſerved by the Ancients, that where a *Rainbow* ſeems to hang, or touch the Earth, there breathes a ſweet Odour. If the Fact be true, the *Cauſe* may be, that this happens in certain Matters, having in themſelves ſome Sweetneſs, which the fine Dew of the Rainbow draws out: for thus ſoft Showers make the Ground ſweet. Perhaps, alſo, the Water itſelf of the Rainbow, has ſome Sweetneſs; for the Rainbow conſiſts of a Collection of ſmall Drops, which cannot poſſibly fall but from the Air that is very low; and therefore may lodge the Sweetneſs of the Herbs and Flowers, as a *diſtilled Water:* for Rain, and other Dew that falls from on high, cannot preſerve the Smell; which is diſſipated in the drawing up. Some Waters alſo, may have a degree of Fragrance; tho we find it ſenſibly in no *Pool*, *River*, or *Fountain:* but clean Earth, newly turned up, hath a Freſhneſs and good Scent; which Water, if it be not too equal and uniform (for equal Objects never move the Senſes) may alſo have. Bay-ſalt, which is but a kind of congeal'd Water, will ſometimes ſmell like Violets [m].

RAREFACTION.

The Cauſe of the Swelling, and Dilatation of Grain in boiling.

Barly ſwells but little in boiling; Wheat more; and Rice extremely, even to three times its Bulk. The *Cauſe* is, that the more cloſe and compact Bodies will dilate the moſt: but Barly is hollow, Wheat more ſolid, and Rice the moſt ſolid of all. Perhaps, alſo, ſome Bodies have a kind of *Lentor*, and a more communicable Nature than others; as we ſee in *Coloration*: for a ſmall Quantity of *Saffron* will tinge more than a great one of *Braſil* [n].

[l] But ſmall Advances have been yet made towards an *inductive Meteorological Hiſtory:* whence moſt Points relating to it, are little better than conjectural; except what the Author has in his *Hiſtory of Winds.*

[m] Conſult, upon this Head, the *Chapter of Water*, in *Boerhaave's Chemiſtry*; and the *Proceſſes upon Vegetables*, in the ſame Work.

[n] Here is an uſeful Subject ſtarted, that might deſerve to be largely proſecuted, in a Hiſtory of dry or ſolid *Panadas*, *Grewels*, *Jellies*, *Mucilages*; and various other ſorts of cheap, parable, and wholeſome *Aliments*, both for the Sick and Sound, as well at Sea as at Land. But the thoughts of ſuch a *Hiſtory* ſeem *nauſeated* by Philoſophers; and, till this *Nauſea* be removed, the Subject muſt skulk in the *Kitchen.*

REJUVENESCENCY.

Of casting the Skin and Shell in some Creatures.

The *casting of the Skin* is, by the *Ancients* compared to the *breaking of the Secundine*; but unjustly: for thus every casting of the Skin were a new Birth: besides, the Secundine is a general Cover, not shaped to the Parts, as the Skin is. The Creatures that cast the Skin are, the *Snake*, the *Viper*, the *Grashopper*, the *Lizard*, the *Silk-worm*, &c. Those that cast the Shell are, the *Lobster*, the *Crab*, the *Craw-fish*, the *Dodman*, the *Tortoise*, &c. The old Skins are found; but the old Shells never [o]: so that, perhaps, they scale off, and crumble away by degrees. This Renovation is known by the extreme tenderness and softness of the new Shell, joined with the freshness of its Colour. The *Cause of casting the Skin and Shell*, should seem to be, (1.) the great Quantity of Matter in those Creatures, fit to produce them; and, (2.) the Looseness of the Skin, or Shell; that sticks not close to the Flesh: for 'tis the new Skin, or Shell, that thrusts off the old. In Deer, 'tis the young Horn that pushes off the old one; in Birds, the young Feathers displace the old: And Birds that have much Matter for the Beak, cast their Beaks; the new ones thrusting off the old [p].

RIGHT AND LEFT.

Of the Right and Left-side.

The Senses are alike strong, both on the Right and Left-side; but the Limbs on the Right-side, are strongest [q]. The *Cause* may be, that the Brain, which is the Instrument of the Sense, is alike on both Sides; whilst the Motion and Hability of Moving, are somewhat forwarded by the Liver; which lies on the Right-side. Perhaps, also, the Senses are exercised indifferently on both Sides, from the Time of Birth; but the Limbs are used most on the Right-side, by *Custom*: for we see some are left-handed; who are such as have used the Left-hand most [r].

S.

SALAMANDER.

How the Salamander may endure the Fire.

THere is an *ancient Tradition* of the *Salamander*, that it lives in, and has the power of extinguishing Fire. If *this be true*, two things are required to the Operation: *first*, a very close Skin, to keep out Flame; which, in the

[o] Consult the *French Memoirs*; and *Philosophical Transactions*, upon this Point.

[p] These are to be understood as *Instances of Approach*, in the Subject of *Rejuvenescency*; that ought to encourage an Enquiry into the Means of renewing the Body in old Age. But Men seem to shew all the Frigidity, and Despondency of Age, on this Occasion.

[q] Except in Left-handed People.

[r] May there not be a particular and original Conformation in the Limbs of some Persons, disposing them to use their Left-hand, or Left-leg, more than their Right? for considerable Pains have been taken, to break some Children of the Habit of using the Left-hand; but without Success. It might likewise deserve to be examined, whether the Right-side Limbs of the Body do not naturally grow larger than the Left, in most People; without their using them more: This should be tried in Ambodexters, *&c.* The Right Testicle seems, generally, bigger than the Left.

the midſt, is not ſo hot: for, if the Palm of the Hand be beſmeared thick with the White of an Egg, and Spirit of Wine be poured upon it, and ſet on fire, one may endure the Flame for ſome time. The *ſecond* thing is an extreme Coldneſs, and quenching Virtue, in the Body of that Creature; which choaks the Fire. We ſee that Milk quenches Wild-fire better than Water; becauſe it enters better [r].

SALT WATER.

A Way of making ſalt Water freſh.

It has been obſerved, that *ſalt Water* boiled, and cooled again, is more potable than when raw; yet the Taſte of the Salt does not riſe in Vapour: for the diſtilled Water proves freſh. The *Cauſe* may be, that the Salt of the Water partly riſes in a kind of Scum, and partly falls in Sediment; and ſo, rather ſeparates than evaporates: a ſaline Taſte being too groſs to riſe in Vapour, as well as a bitter one; for the ſimple diſtilled Waters of Wormwood, and the like bitter Plants, are not bitter [s]. See the *Article* PERCOLATION.

SEA.

The different Clearneſs of the Sea.

1. The Sea is clearer when the North, than when the South-wind blows: for *ſalt Water* has a little Oilineſs on its Surface; as appears in very hot Days. And again, a South-wind ſomewhat warms or relaxes the Water; and no Water when boiling, is ſo clear as when cold [v].

The Cauſe of the rolling and breaking of the Sea.

2. Shallow, narrow Seas break more than deep and large ones: for the Impulſe being the ſame in both; where there is a greater Quantity of Water, and Space enough, the Water rolls and moves more ſlowly, and with a ſloper Riſe and Fall: but where there is leſs Water, leſs Space, and the Wa-

[r] Theſe Intimations of the Author receive great Confirmation from the Obſervations of M. *Maupertuis*, made upon the *Land Salamander*; and publiſhed in the *French Memoirs* for the Year 1727.

[s] The due proſecution of this *Enquiry* requires a Diſtinction to be obſerved betwixt *Salt-Water* and *Sea-Water*; otherwiſe many fruitleſs Experiments may be made for ſeparating common Salt, diſſolved in common Water, that ſhall by no means come up to the Caſe of rendering *Sea-Water* ſweet and potable. An exact *Analyſis of Sea-Water* ſeems hitherto wanting; to ſhew its ſeveral Ingredients, and their Proportions. Thus it may, upon Examination, be found to contain a bitter unctuous or bituminous Matter, and the putrefied Subſtance of Fiſh, *&c.* as well as a certain Proportion of common Salt; and it muſt be purified from all theſe, before it can ſerve the Purpoſes of common Water. What Effect will the *Filtring-ſtone* have, in ſeparating the foul, unctuous, putrefied, and ſaline Parts of Sea-Water? Who has ſhewn the Methods that ſeem beſt adapted for obtaining of this End; whether *Precipitation*, *Separation*, *Percolation*, *Inverſion*, *Diſtillation*, or *Congelation*? There are ſome Hints to this Purpoſe in the Writings of Mr. *Boyle*; the *Philoſophical Tranſactions*; and the *French Memoirs*.

[v] There may be ſomewhat optical in this caſe, beſides the Cauſes here aſſigned: thus, for Inſtance; a River, or the Sea, will ſometimes appear clear and undiſturbed on one hand, and muddy, or ruffled on the other; according to the Situation of the Eye: or as ſome light Breeze catches the Surface of the Water, and ruffles it in a particular Part. But for the Clearneſs of the Sea, at great Depths, ſee Dr. *Halley*'s *Account of the Diving-Bell*, in the *Philoſophical Tranſactions*.

ter dashes more against the Bottom, it moves swifter, and more perpendicularly; for in the breaking of Waves, there is always a Precipice [u].

SENSES.

The Cause of the Pleasures and Displeasures of the Senses.

Harsh Sounds, as that of a Saw when it is filing, make a Shivering or Horror in the Body, and set the Teeth on edge; for the Objects of the Ear affect the Spirits immediately, either with Pleasure or Offence: but no Colour affects the Eye with great Displeasure. There are, indeed, Sights that are horrible; because they excite the Memory of things odious: whilst the same things painted, have little effect. But for *Smells*, *Tastes*, and *Touches*, they affect by a Participation, or Impulse of the Body of the Object. 'Tis *Sound* alone, that affects most immediately and incorporeally. This is manifest in Musick, with its Concords and Discords; for all Sounds, whether sharp or flat, if they be sweet, have a Roundness and Equality; and if harsh, are unequal: for a Discord itself, is but a Harshness of differing concurrent Sounds. 'Tis true, Inequality not dwelt upon, but transient, is rather an Increase of Sweetness; as in the Purling of a wreathed String; the Hoarseness of a Trumpet; and the Nightingal-pipe of a Regal; and in a Discord falling directly upon a Concord: but dwelt upon, 'tis offensive. Hence there are three degrees of Pleasure and Displeasure, in Sounds; *viz.* sweet Sounds, Discords, and harsh Sounds, which are differently named, *Shrieking*, *Grating*, &c. As for setting the Teeth on edge; we may plainly observe, what an Intercourse there is between the Teeth and the Organ of Hearing, by taking the End of a Bow in the Teeth, and striking upon the String [w].

SEPARATION OF BODIES BY GRAVITY.

Intimations of Ways for separating Liquors by Gravity.

1. Put Water into the Belly of a Glass-Egg, and a parcel of Claret and Water, mixed, into another open Glass; invert the Stem of the Egg into the Wine and Water, stopping the Orifice with the Finger; then removing the Finger, continue the Glass in the same Posture; and it will unmix the Wine from the Water: the Wine ascending to the Top of the upper Glass, and the Water descending to the Bottom of the lower [x]. The Operation is apparent to the Eye; for the Wine will visibly rise, in a small Vein, thro' the Water. To render the Experiment more elegant, and because it requires some small time, the upper Glass may be suspended: but as soon as there is so much pure unmixed Water collected in the Bottom of the lower Glass, that the Mouth of the upper dips into it, the Motion ceases.

2. If

[u] See more to this Purpose in the Author's Account of the *Ebbing and Flowing of the Sea*; in the PHILOSOPHIA PRIMA.

[w] See this Subject farther prosecuted under the *Articles* AFFECTIONS, MUSICK, ODOURS, and SOUND.

[x] There is some Caution required to make the Experiment succeed; particularly, the Stem of the Glass-Egg should be slender.

2. If the upper Glaſs be charged with Wine, and the lower with Water, there follows no Motion at all: and if the upper Glaſs be of pure Water, and the lower of Water coloured, there follows no Motion. But it has been tried, that tho the Mixture of Wine and Water, in the lower Glaſs, be three parts Water to one of Wine, it does not ſlacken the Motion. This Separation of Wine and Water appears to be made by Gravity: for it only ſucceeds in Bodies of unequal Gravity; and the heavier Body muſt always be in the upper Glaſs: but then obſerve, that the Water being penſile, and there being a great weight of Water in the Belly of the Glaſs, ſuſtained by a ſmall Pillar of Water in the Neck, is the Thing that gives the Motion; for Water and Wine in one Glaſs, will hardly ſeparate by long ſtanding.

3. This Experiment ſhould be extended to Mixtures of different Liquors, and to Fluids which conſiſt of ſeveral ſimilar Parts: try it therefore with Brine, or ſalt Water, and freſh Water; placing the ſalt Water in the upper Glaſs, to ſee whether the freſh will riſe. Try it, alſo, with Water ſugared, and pure; to ſee whether the Water that riſes will loſe its Sweetneſs: for which Purpoſes, it were proper to have a little Stop-cock in the Belly of the upper Glaſs [y].

SHADOWS.

The Motion of Shadows.

The Extremities of Shadows always ſeem to tremble; becauſe the little Motes in the Sun are conſtantly in motion; tho there be no Wind: and theſe moving in the Meeting of the Light and Shade, from the Light to the Shade, and from the Shade to the Light, may make the Shadow appear to move, becauſe the Medium moves [z].

SHELL-FISH.

The Nature of Shell-fiſh.

Shell-fiſh have been compared, and ranked with Inſects; but, I know not why: for they have Male and Female, like other Fiſh; and are not bred of Putrefaction. Indeed Oiſters, Cockles, and Muſcles, which have no local Motion, have no diſcriminate Sex. *Quære*, in what time, and how they are bred? It ſeems, that Shells of Oiſters grow where there were none before; and the great Horſe-muſcle, with the fine Shell, found in Ponds, has bred within thirty Years: but then, they not only open and ſhut, as Oiſters do, but alſo remove from place to place [a].

SICK-

[y] This being tried with Red *Port-Wine* and *Water*; there was no manifeſt Separation in a Month's time.

[z] The Experiments of this kind are attended with Difficulties, and not yet brought to Perfection. See the Essay lately publiſhed for *Concentrating Wines, and other fermented Liquors, or taking their ſuperfluous Waters out of them to Advantage.*

[a] See more to this Purpoſe in Sir *Iſaac Newton's Opticks.*

[b] Thus, at the Bottom of dry Ponds where Muſcles are, 'tis uſual to find ſeveral long Traces, made by the Motion of the Muſcle that lies at the End of each Trace, reſpectively. There is a curious Paper upon this Subject of Muſcles, in the *French Memoirs.*

SICKNESS.

Why more are ſick in Summer, but moſt die in Winter.

1. 'Tis common for more to be ſick in Summer, and more to die in the Winter; except in peſtilential Diſeaſes, which uſually reign in the Summer, or Autumn. The *Reaſon* ſeems to be, that Diſeaſes are chiefly *cauſed* by Heat [c]; and chiefly cured by Sweating and Purging: which Operations are more eaſily excited in Summer. But moſt die of *peſtilential Diſeaſes* in Summer; becauſe theſe breed moſt in that Seaſon: otherwiſe the Conſtitutions that are touched, run the greateſt Danger in Winter.

Whether Heat and Moiſture be the Cauſe of Peſtilences.

2. 'Tis a general Opinion, that hot and moiſt Years are moſt peſtilential; and, that Heat and Moiſture cauſe Putrefaction upon the Surface of the Earth. In *England*, this is not true; for there have often been great Plagues in dry Years: perhaps, becauſe Drought, in the Bodies of the Iſlanders, accuſtomed to a moiſt Air, exaſperates the Humours, and makes them more apt to putrefy, or inflame: beſides, it commonly taints the Waters, and makes them leſs wholeſome. Again, in *Barbary*, Plagues break out in the Summer Months; when the Weather is hot and dry.

Epidemical Diſeaſes owing to a Series of the Seaſons.

3. Many Diſeaſes rage at particular times: the *Cauſe* whereof is falſly imputed to the *Conſtitution of the Air* at that time; being, in reality, owing to a *Series of the Seaſons of the Year*: whence *Hipocrates*, in his *Prognoſticks*, juſtly obſerves the Diſeaſes that enſue upon the Nature of the four precedent Seaſons of the Year [d].

SLEEP.

Creatures that ſleep all Winter.

1. There are many Creatures that ſleep all the Winter; as the Bear, the Hedge-hog, the Bat, the Bee, *&c.* and they all grow fat by ſleeping; and void nothing. The *Cauſe* of their fattening may be, the Want of Aſſimilation; for whatever does not aſſimilate to Fleſh, turns either to Sweat, or Fat. Theſe Creatures, for one part of their ſleeping Time, have not been obſerved to ſtir; and, for the other part, to ſtir, but not to remove: and they chuſe warm, cloſe Places, to ſleep in. When the *Dutch* wintered in *Nova Zembla*, the Bears went to ſleep about the middle of *November*; and then the Foxes, which durſt not appear before, began to come abroad. 'Tis obſerved, by ſome, that the She-bear breeds, and lies with her Litter, during this time of Reſt: and, that a Bear big with Cub, has been ſeldom ſeen.

2. Thoſe

[c] This ſeems to hold of *inflammatory Diſeaſes*; which are, perhaps, by much, the greateſt Number.

[d] There is Matter of Inſtruction here laid down, in order to a *Natural Hiſtory of Diſeaſes*: a thing greatly wanted; if it could be procured without any Mixture of *Hypotheſis*, *Fiction*, and *Fancy*, wherewith the Writings of Phyſicians generally abound. But no great Progreſs can well be expected in it, without a previous Enquiry into the *Natural Chemiſtry of the Weather*, and its Effects on the Body, thro' the different Seaſons of the Year. See the Author's *Hiſtory of Winds*.

2. Thoſe that are very cold, eſpecially in their Feet, cannot ſoon go to ſleep. The *Cauſe* may be, that Sleep requires a free Reſpiration, which Cold hinders; for in great Colds a Man can ſcarce draw Breath. Another *Cauſe* may be, that Cold calls out the Spirits to aſſiſt againſt it: whence they cannot ſo well come together, and collect in the Head; which is always required in Sleep. And, for the ſame Reaſon, Pain and Noiſe prevent Sleep; which Darkneſs promotes. *How Cold may hinder Sleep.*

3. Some Sounds incline to Sleep; as the blowing of the Wind, the trickling of Water, the humming of Bees, ſoft Singing, Reading, *&c.* The *Cauſe* is, that they move in the Spirits, only a ſoft and gentle Attention; and whatever moves Attention, without too much Labour, ſtills the natural and diſcurſive Motion of the Spirits. *Why ſome Sounds promote Sleep.*

4. Sleep nouriſhes, or, at leaſt, preſerves Bodies a long time. Beaſts that ſleep the Winter, grow fat tho they eat nothing. Bats have been found in Ovens, and other hollow, cloſe Places, matted one upon another; whence, 'tis probable, they ſleep in the Winter, and eat nothing. *Quære*, whether Bees do not ſleep all the Winter; and ſpare their Honey? Butter-flies, and other Flies, not only ſleep, but lie as dead, all Winter; yet revive again, with a little heat of the Sun, or a Fire. A Dormouſe will ſleep for ſome Days together, both in Winter and Summer, without eating [e]. *That Sleep may nouriſh.*

SNEEZING.

Looking againſt the Sun provokes Sneezing [f]; not by heating the Noſtrils; but by drawing down the moiſture of the Brain: for it will make the Eyes run with Water; and the drawing of Moiſture to the Eyes, draws it to the Noſtrils, by conſent; whence follows Sneezing: as, contrariwiſe, the tickling of the Noſtrils within-ſide, draws Moiſture to the Noſtrils, and to the Eyes by conſent; for they, alſo, will water. Yet it has been obſerved, that if a Perſon be going to ſneeze; the rubbing of the Eyes, till they water, will prevent it: the Humour, which was deſcending to the Noſtrils, being thus diverted to the Eyes [g]. *The Cauſe of* Sneezing.

[e] There are many Particulars relating to this *Hiſtory of Sleep*, to be found in Mr. *Boyle's Philoſophical Works*; the *Philoſophical Tranſactions*, &c. But the Subject requires to be farther continued, in the *inductive Method*. See the Author's *Hiſtory of Life and Death*.

[f] This perhaps may have ſometimes been tried without Succeſs.

[g] The preſent *Anatomy*, and *Phyſiology*, ſcarce reach to theſe ſubtile Operations of the Body: nor can we hope to ſee their *Cauſes* inveſtigated, without proper Sets of Experiments, which few ſeem, hitherto, diſpoſed to make. Certainly, a more active and penetrating Philoſophy is here required, than the vulgar Philoſophers are apprized of; as conſiſting, not in the groſs, but almoſt infinitely fine Particles of Matter, which too commonly paſs for notional things; tho the immediate *Inſtruments* of all the more ſubtile Operations. But, perhaps, the Time for theſe things is not yet.

A Draught for the particular HISTORY *of* PHONICKS: *or the Doctrine of* SOUND *and* HEARING.

INTRODUCTION.

SOUND is a capital Thing, and a great Secret in Nature; as having a Virtue that may be call'd incorporeal: whereof there are but few other *Inſtances.* And beſides the more obvious Uſes of an *Enquiry* into this Subject, it affords a proper Exerciſe to the Underſtanding, by mixing the Contemplation of ſpiritual Species, and Operations at a diſtance; with the Conſideration of ſuch Things as operate only by a Communication of Subſtance to the Touch. Whence the Mind now called off from Matter, may be rectified, and taught to become impartial [a]. But certain Obſervations upon *Sounds*, having given Birth to the *Art of Muſick* [b]; it happens here, as it generally does, that when *Experiments* and *Obſervations* are grown into an Art; the *Mathematical* and *Practical* Parts of that Art improve, whilſt its *Phyſical* Part is deſerted. It has fared ſomewhat better with *Opticks*; which conſiders not only Painting, Beauty and Symmetry, but all viſible Objects; whereas Muſick confines itſelf only to harmonick Tones; which is a narrow Field: But the Buſineſs of *Sound* and *Hearing* ſhould be well laboured in all its Parts; and brought into a full and extenſive *Hiſtory* [c].

[a] See this Direction explained in the *Novum Organum*, Part I. Sect. II, 18, *&c.*

[b] See the *Article* MUSICK.

[c] The following is a large *Example* of a *Hiſtory conducted* according to the Direction of the *Novum Organum*; and a Specimen how all the *Articles* of the *Sylva Sylvarum* would have been treated, had the Author lived to execute his vaſt Deſign. Indeed the preſent *Enquiry*, tho not finiſhed, is proſecuted to ſuch a length as might recommend it to a place in the fourth Part of the INSTAURATION; if the Author had not here intended it as a Model of his Method of proſecuting Enquiries; ſo as in the *Third Part* of his *grand* WORK, to give ſome Earneſt of the *Fourth*: which is a Rule he appears to obſerve in all the *Parts* that are touched upon.

A Table of Enquiry, for the particular HISTORY *of* PHONICKS.

ARTICLE I.

OF the Exiſtence and Non-exiſtence of Sounds.

ARTICLE II.

Of the Production, Conſervation, and Propagation of Sounds.

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Of the Paſſage and Interception of Sounds.

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Of the Medium of Sounds.

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ARTICLE XVI.

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Of the Relation and Difference betwixt Light and Sound.

ARTICLE XXI.

Of the Sympathy and Antipathy of Sounds with one another.

ARTICLE XXII.

Of the Means of Hindering or Improving the Hearing.

ARTICLE XXIII.

Of the ſpiritual and fine Nature of Sounds [d].

SECT. I.

Of the Exiſtence and Non-exiſtence of Sounds.

Inſtances of great Motions without Sound. In the Celeſtial Bodies.

1. LET us firſt conſider what great Motions there are in Nature, that paſs without Sound, or Noiſe. The Heavens revolve in a rapid Motion, without Noiſe; tho, by ſome Dreamers, they have been ſaid to make excellent Muſick. The Motions of the *Comets* yield no Noiſe. And if it be thought that the greatneſs of their Diſtance will not let the Sound

[d] Theſe are the ſeveral ARTICLES, or HEADS OF ENQUIRY, which occur upon the firſt ſedate Conſideration of the Subject; and which being duly enlarged, enquired into, and the neceſſary *Experiments*, *Obſervations* and *Inſtances* produced, lead to a Knowledge of its *Nature and Properties*; or what, in the Language of the Author, is term'd its FORM. But till theſe *Articles* are all filled up, the *Inſtances* produced, and the whole extended, verified, and deduced into *Axioms*, 'tis no more than a *Sylva*, or bare Collection of the Materials for a particular *Hiſtory* of *Phonicks*.

Sound be heard; we ſay that Lightnings, and Corruſcations, which are near at hand, yield no Sound: yet in all theſe, there is a Percuſſion and Separation of the Medium.

2. The Winds in the upper Region, blow without Noiſe. The lower Winds, in an open Plain, make no Noiſe; unleſs they be violent: but among Trees their Noiſe is perceptible. And the Sound of Winds is generally unequal, or in the way of riſing and falling; and ſometimes, when vehement, trembling at the height of their Blaſt. *Winds.*

3. Rain or Hail, tho falling violently, yield no Noiſe in paſſing thro' the Air, till they reach the Ground, Water, Houſes, or the like. The Water of a River is not heard in the Channel; but runs ſilent, if it be of any depth: whilſt the ſmaller Streams upon Shallows of Gravel, or Pebble, make an audible Noiſe. And Waters when they beat upon the Shore, or are ſtraitned, as in the Falls of Bridges, or when daſhed againſt themſelves, by Winds, make a loud roaring. *Waters.*

4. Any piece of Timber, or hard Body, being thruſt forwards by another contiguous to it, without knocking, gives no Noiſe. And ſo Bodies in weighing upon one another, tho the upper preſs the lower, make no Noiſe. Thus the Motion in the minute Parts of any Solid, paſſes without Sound; the Sound being here produced only by the breaking of the Air, and not by the impulſe of the Parts: ſo that where the anterior Body gives way as faſt as the poſterior comes on, no Noiſe is made; be the Motion ever ſo great or ſwift. *Solids.*

5. Air open, and at large, makes no Noiſe, unleſs it be ſharply ſtruck; as in the Sound of a String; where the Air is briskly ſtruck by a hard and ſtiff Body: for if the String be not ſtrain'd, it makes no Noiſe. But where the Air is confin'd and ſtraitned; the Breath, or other blowing, with a gentle Percuſſion, ſuffices to create Sound; as in Pipes, and Wind-Inſtruments. But in Flutes, which require only a ſoft Breath, the Concavity of the Inſtrument would yield no Sound, were it not for the Fipple that ſtraitens the Air. Other Wind-Inſtruments, as Trumpets, Cornets, Horns, *&c.* require a forcible Breath; as appears by the inflated Cheeks of the Blower. Organs alſo are blown with a ſtrong Wind, by the means of Bellows. And ſome kinds of Wind-Inſtruments are ſounded at a ſmall Hole on the ſide[e], which ſtraitens the Breath at the firſt Entrance: and this the rather, on account of their Traverſe and Stop above the Hole; which performs the part of the Fipple, in Flutes and Fifes, that give no Sound when blown at the wrong end, as Recorders do. So in Whiſtling, 'tis uſual to contract the Mouth; and to make the Tone more ſharp, they ſometimes uſe the Finger. But if a Stone, or a Dart, be thrown in the open Air, they give no Sound: no more do Bullets, unleſs they happen to be a little hollow'd in the caſting; which hollowneſs receives and confines the Air[f]. Arrows, likewiſe, whiz not *Inſtances of ſmaller Motions, with and without Sound. In Muſical Inſtruments, &c.*

[e] As the *German Flute*, for Inſtance.

[f] Suppoſe a Braſs Bullet turned exactly ſmooth, and diſcharged in the common manner; will it make no ſenſible whizzing as it flies thro' the Air?

in their Flight, except their Feathers are ruffled; which likewiſe obſtructs and confines the Air. But ſmall Whiſtles give a Sound, on account of their extreme ſlenderneſs; whereby the Air is more confin'd than in a wider Bore. Again, the Voices of Men, and other Animals, paſs thro' the Throat; which confines the Breath. The *Jews-Harp* requires but a ſmall Percuſſion; and has alſo the advantage of confining the Air in the Mouth.

Solids, Air, and Flame. 6. Solid Bodies, if gently ſtruck, give no Sound; as when a Perſon treads ſoftly upon a Floor. So Cheſts or Doors in dry Weather, when they open eaſily, make no Noiſe: and Cart-wheels ſqueak not if they are greaſed. The Flame of Tapers, tho it be a ſwift Motion, and breaks the Air, yet paſſes without Sound. The Air in Ovens, tho it doubtleſs boils, as it were, dilates itſelf, and is beat back; yet makes no Noiſe. Flame repulſed by Air, affords a Noiſe; as in blowing the Fire with Bellows; greater than if the Bellows were to blow upon the Air itſelf. So likewiſe Flame ſtriking the Air ſtrongly, makes a Sound: and great Flames, roar whilſt one impells another.

White Powder. 7. There goes a Rumour of a kind of *white Gunpowder*, which will diſcharge a Piece without Noiſe: and it is a dangerous Experiment if true[g]. But it ſeems to me impoſſible; for if confined Air be driven out, and ſtrike the open Air, it will certainly make a Noiſe[h]. As for the *white Powder*, it may be a mixture of *Nitre*, Sulphur, and a little Camphire, without Coal; for Nitre alone will not take Fire: nor is it probable, that the Sound ſhou'd be damp'd or deaden'd by diſcharging the condenſed Air, before it comes to the Mouth of the Piece, and the open Air; for it will thus only make more divided Sounds. If it were poſſible, there ſhould be no Air confined at the Mouth of the Piece, the Bullet might go away with little Noiſe: For the Percuſſion of the Flame upon the Bullet, makes no Noiſe: the Bullet in paſſing thro' the Air, makes but little; and if no confined Air were to ſtrike upon the open Air, there is no Cauſe of Sound; yet the Bullet's Motion will not be ſtopped. So that the trial may be made, by filling a little hollow metalline Cylinder with Powder; and laying the Bullet in the Mouth of it, ſo as to reach half out into the open Air.

Burning-Glaſſes. 8. I heard it affirm'd by a great, tho vain, Dealer in Secrets, that there was a Conſpiracy, which himſelf hindred, to have kill'd Queen *Mary*, Siſter to Queen *Elizabeth*, by a *Burning-Glaſs*, from the Leads of the Houſe, as ſhe walked in St. *James*'s Park. And if Burning glaſſes could be brought to a great degree of ſtrength, (and they talk of Glaſſes able to fire a Navy) the

[g] White Gunpowder has frequently been made by uſing *Touch-wood*, which is white, inſtead of Willow-Coal, which being black, communicates a duſky Hue to the common Gunpowder. But this kind of white Powder ſtill makes a Report; ſo does the common white *Pulvis fulminans*: but what approaches the neareſt of any thing yet diſcovered, to the Deſign of the *white Powder* here underſtood, is, perhaps, *condenſed Air*, in the *Wind-Gun*; which, when well made, is indeed a highly dangerous and deſtructive Engine; capable of doing Execution, where its ſlender and ſhort-lived hiſſing Report cannot be heard.

[h] So it does in the *Wind-Gun*; but nothing like the Noiſe of *Gunpowder*, even when the Wind-Gun is high charged with condenſed Air; ſo as to throw out twenty Bullets ſucceſſively; in the ſpace of a Minute.

the Percuſſion of the Air alone, by ſuch a *Burning-glaſs*, would make no Noiſe; any more than Corruſcations and Lightnings, without Thunder.

9. I ſuppoſe the Impreſſion of the Air by *Sounds*, requires time to reach the Senſe, as well as the Impreſſion of viſible Objects; and will not otherwiſe be heard. Therefore, as a Bullet from a Cannon, moves ſo ſwift, as to be inviſible[i]; the ſame ſwiftneſs of Motion makes it inaudible: for the apprehenſion of the Eye, is quicker than that of the Ear. *Time required to render Sounds perceptible.*

10. All Eruptions of Air, tho ſmall and light, cauſe the *Sounds* called crackling, puffing, ſpitting, *&c.* as in Salt, Bay-leaves, and Cheſtnuts, thrown into the Fire: So Candles will ſpit Flame, if they be wet, *&c.* *The ſmaller Sounds, by Eruption of Air.*

SECT. II.

Of the Production, Conſervation, and Propagation of Sounds.

1. THE *Cauſe* commonly aſſign'd of Sound, *viz.* the *Eliſion of the Air*[k], is but a Term of Ignorance; and the Notion but a catch of the Wit upon a few *Inſtances*; as the manner is, in the received *Philoſophy*. And 'tis a common way with Men, when once they have got a pretty Expreſſion, or a Term of Art, by the End; to let it go current: tho it be empty of Matter. This Conceit of *Eliſion* appears manifeſtly falſe; becauſe the Sound of a Bell, a muſical String, or the like, continues melting for ſome time after the Percuſſion; but ceaſes preſently, if the Bell, or String be touched and ſtayed: whereas if an *Eliſion of the Air* made the Sound; the touch of the Bell or String could not ſo ſuddenly extinguiſh the Motion cauſed by an *Eliſion of the Air*. This appears ſtill more plain by chiming, with a Hammer, upon the out-ſide of a Bell; for the Sound will thus be made according to the inward Concave of the Bell: whereas the *Eliſion of the Air* can be only between the Hammer and the out-ſide of the Bell. So again, if *Eliſion* were the Cauſe; a broad Hammer, and a Bodkin, ſtruck upon Metal; would give different Tones, as well as a different Loudneſs; which they do not: for tho the Sound of the one be louder, and of the other ſofter; yet the Tone is the ſame[l]. Beſides in *Echoes*, whereof *Sound falſely attributed to Eliſion of the Air.*

[i] Red hot Bullets diſcharged in the dark are viſible: and ſo, perhaps, are *Braſs Bullets* diſcharged by Day; when the Spectator ſtands with his back to the Sun, whilſt the Sun's Rays play directly upon the Ball in its Motion.

[k] That is in plain Words, the Squeezing, Preſſing, or Cutting of the Air; as betwixt the Hammer and Anvil the Bell and its Clapper, the Finger and a muſical String, *&c.*

[l] 'Tis a Difficulty with many to acquire a juſt Notion of this Matter; and the Thing itſelf is ſeldom clearly made out, how a Bell, or a muſical String, ſtruck in any Part, or with any degree of Force, ſhould ſtill give one and the ſame *Tone*, differing only in *Loudneſs* or *Lowneſs*. The Knowledge of this is rather to be acquired by the Ear, and Experience, than by Words. But if farther Direction be required, conſult Mr. *Malcolm's Treatiſe of Muſick*. See alſo below, SECT. IV. and VIII.

whereof ſome are as loud as the original Voice, there is no new *Eliſion*; but only a Repercuſſion. Theſe and the like Conceits, will ſcatter and break up like a Miſt; when Men ſhall have cleared their Underſtanding, by the Light of Experience.

That local Motion of the Air is not neceſſary to Sound.

2. 'Tis certain, that *Sound* is not produced at the firſt, without ſome local Motion of the Air, Flame, or other Medium; nor without ſome Reſiſtance, either in the Medium or Body ſtruck. For a mere yielding, or ceſſion, produces no Sound. And herein Sounds differ from Light and Colours, which paſs thro' the Air, or other Medium; without any local Motion of the Air, either at the firſt, or after. But we muſt attentively diſtinguiſh between the local Motion of the Air, and the Sounds conveyed in the Air. As to the former, we manifeſtly perceive, that no Sound is produced without a perceptible blaſt of the Air; or without ſome reſiſtance of the Air that is ſtruck. For even Speech, one of the gentleſt Motions of Air, is attended with the Expulſion of a little Breath. And all Pipes or Wind-Inſtruments have a Blaſt, as well as a Sound. We find alſo that Sounds are carried by the Wind, and therefore will be heard farther with the Wind, than againſt it; and that they likewiſe riſe and fall with the intenſion or remiſſion of the Wind [m]. But for the Impreſſion of *Sound*, 'tis quite another thing; and entirely without any perceptible local Motion of the Air: in which it reſembles *Viſion* [n]; for after a Bell is rung, we diſcern no perceptible Motion of the Air, in the track where the Sound goes, but only at the firſt. Nor does the Wind, in carrying a Voice, by its Motion, confound any of the delicate and articulate Figurations of the Air, in the variety of words. And to ſpeak loud againſt the Flame of a Candle, will not make the Flame tremble conſiderably; tho moſt when thoſe Letters are pronounced which contract the Mouth; as F, S, U, *&c.* But gentle Breathing, or Blowing, without ſpeaking, will move the Flame much more. And probably Sound is the rather without any local Motion of the Air; becauſe, as it differs from Sight, in requiring a local Motion at firſt; ſo it reſembles it in many other Things, which induce no local Motion [o].

Seeming Inſtances of the contrary.

3. On the other Hand, Glaſs Windows will ſhake with Thunder, and the firing of Ordnance; and Fiſhes are thought to be frighted with the Motion, cauſed by Noiſe upon the Water: But theſe effects proceed from the local Motion of the Air, which is a Concomitant of the Sound; and not from the Sound itſelf. It is alſo ſaid, that violent Shoutings of People in great Mutlitudes, have ſo rarified the Air, that Birds upon the Wing have fallen down; the Air being thus render'd unable to ſupport them [p]. And 'tis believed

[m] See Mr. *Derham's* Paper upon the *Motion of Sound*, in the *Philoſophical Tranſactions*, N° 313.

[n] See the *Biſhop of Fern's* Paper upon *Acouſticks*, in the *Philoſophical Tranſactions*, N° 156. And Dr. *Grandi's* Conſiderations upon it, N° 319.

[o] See the Paper above cited.

[p] Allowing that Birds have been made to fall down by loud Shouting, it does not follow that the Air muſt have been rarified by the Noiſe: for the Birds may only be thus frighted by the Noiſe, ſo as to fall down.

lieved by ſome, that violent ringing of Bells in populous Cities, has chaſed away Thunder; and alſo diſſipated peſtilent Air: all which *if real*, may proceed from the *Concuſſion of the Air*, and not from the Sound. A very great Sound, near at hand, has ſtruck many with deafneſs; and at the Inſtant they have found, as it were, the breaking of a Skin or Parchment in their Ears [q]: and myſelf ſtanding near a Perſon who lured loud and ſhrill, ſuddenly received an Injury; as if ſomewhat had broke, or been diſlocated in my Ear; and immediately after enſued the Senſation of a loud Ringing; ſo that I apprehended ſome Deafneſs: But it vaniſhed in half a quarter of an Hour. This effect may be juſtly refer'd to the Sound; for an over potent Object deſtroys the Senſes: and ſpiritual Species, both viſible and audible, will affect the Senſories, tho they move no other Body.

4. In the *Propagation of Sounds*, Encloſure of them preſerves, and carries them farther. Thus in Rolls of Parchment, or ſhooting Trunks, the Mouth being applied to one end of the Roll or Trunk, and the Ear to the other; the Sound is heard much farther than in the open Air: for the Sound ſpends and diſſipates in the open Air; but is conſerved and contracted in ſuch Concaves. So, if one Man ſpeak in the Touch-hole of a piece of Ordnance; and another apply his Ear to the Mouth of the Piece; the Sound is much better heard than in the open Air. 'Tis farther to be conſidered, what the Event will prove, when the Sound is not encloſed all the Length of its way, but paſſes in part thro' open Air; as when one ſpeaks at ſome diſtance from a ſhooting Trunk; or where the Ear is at ſome Diſtance from the other end of the Trunk; or where both the Mouth and Ear are diſtant from the Trunk. It has been found that in a Trunk of eight or ten Foot, the Sound is helped, tho both the Mouth and the Ear be four or five Inches from the Ends of the Trunk; and ſomewhat farther aſſiſted when the Ear of the Hearer, than when the Mouth of the Speaker, is near. And 'tis certain, that a voice is better heard within a Chamber from without, than without from within the Chamber. And as an entire Encloſure preſerves the Sound, ſo does a Semi-concave; tho in a leſs degree. Therefore, if a Perſon ſpeak at one end of a half Tube, or Trunk, and you lay your Ear to the other; this will carry the Voice farther, than to ſpeak in the Air at large. Nay, if it be not a Semi-concave; but the like be done along the Maſt of a Ship, or the outſide of a piece of Ordnance; tho this be on a Convex Surface, the Voice will be heard farther than in the open Air. It ſhould be tried, how, and with what proportion of Diſadvantage, the Voice will be carried in a Horn, or an arch'd Line; or in a Trumpet, which is a retorted Line; or in a Pipe, that is ſinuous [r].

Sounds preſerved by Encloſure.

5. 'Tis certain, that Sounds are producible without Air; tho this be the moſt favourable Medium thereof. For a pair of Tongs open'd and ſhut at ſome depth within Water, may be heard without any great Diminution of the Sound; tho there is no Air at all preſent. Take one Veſſel of Silver, and

Sounds producible without Air, viz. in Water.

[q] Hence, perhaps, ſome Countenance to the Opinion, that the Drum of the Ear was the Inſtrument of Hearing. But this is not well confirmed.

[r] There remain many Experiments of this kind to be tried.

and another of Wood, fill each of them with Water, and then ſtrike the Tongs together, as before, about four Inches from the Bottom; and the Sound in the Silver Veſſel will be much more reſonant than in that of Wood: yet if there be no Water in the Veſſel, ſo that the Tongs play in the Air, there will be no difference between the Sound coming from the ſilver or the wooden Veſſel. Whence, beſides the capital Point of producing Sound without Air, we may collect, that the Sound communicates with the bottom of the Veſſel; and that ſuch a Communication paſſes better thro' Water than Air.

In Flame. 6. Strike any hard Bodies together, in the midſt of Flame; and the Sound will differ little from the Sound in Air.

By means of the pneumatical Parts in Bodies. 7. The pneumatical Part, which is in all tangible Bodies, and has ſome Affinity with Air, performs, after a ſort, the Office of the Air: Thus the Sound of an empty Barrel, is in part, created by the Air on the outſide; and in part, by that in the inſide; for the Sound will be leſs, or greater, as the Barrel is more or leſs empty: tho it communicates alſo with the Spirit in the Wood, thro' which it paſſes from the outſide to the inſide. So likewiſe in the Chiming of Bells on the outſide; the Sound paſſes to the inſide.

The Phyſical Production of Sound in Strings. 8. It were groſs to think, that the Sound in Strings is produced between the Finger and the String: for theſe are but Preparatories to the production of the Sound, which is form'd between the String and the Air; and that not by any impulſe of the Air, from the firſt Motion of the String; but by the return of the String (now ſtrain'd by the Touch) to its former place: which Motion of Return, is quick and ſharp; whereas the firſt Motion is ſoft, and dull. So the Bow tortures the String continually, and thereby holds it in a conſtant Trepidation.

SECT. III.

Of the Magnitude, Smallneſs, and Damps of Sounds.

The ways of increaſing the ſtrength and deepneſs of Sounds in Horns. 1. LET one Perſon whiſtle at one end of a ſhooting Trunk, whilſt another holds his Ear at the other end; and the Sound will ſtrike the Ear ſo ſharp as to be ſcarce tolerable: for Sound naturally diffuſes in a Sphere, and ſo ſpends itſelf; but if made to go in a Canal, it muſt needs acquire greater Force: And thus Encloſures not only preſerve, but alſo increaſe and ſharpen Sounds [f]. A *French* Horn being greater at one

[f] Does not this Experiment give ſome Light to the *Biſhop* of *Fern*'s *firſt* and *ſecond Problem*; viz. (1.) *To make the leaſt Sounds, by the help of Inſtruments, as loud as the greateſt; a Whiſper to become as loud as the Report of a Cannon?* and, (2.) *To propagate any, the leaſt, Sound to the greateſt Diſtance?* Whoever underſtands the Scope and Tendency of the preſent Enquiry, will not, perhaps, be at a Loſs, to make ſeveral Diſcoveries in *Phonicks*, intimated, but not divulged, by that learned Prelate; and even to carry the Doctrine of *Acouſticks*, *Diacouſticks*, and *Catacouſticks* farther than his Intimations reach. See *Philoſophical Tranſactions*, N° 319. And conſult Dr. *Hook*'s *Poſthumous Works*.

one end than at the other, increaſes the Sound more than if the Horn were of an equal Bore: for the Air and Sound, being firſt contracted at the leſſer end, and afterwards having more room to ſpread at the greater, dilate themſelves; and in coming out ſtrike more Air, whereby the Sound is render'd larger and deeper. And even Hunters Horns, which are commonly made ſtrait, not oblique as the former, are always greater at the lower end. It ſhould be tried alſo in Pipes, made much larger at the lower end: or with a Belly towards the end, and then iſſuing in a ſtrait Concave again.

In particular Buildings.

2. There is in St. *James*'s Fields a Conduit of Brick, with a low Vault adjoining; and at the end of that, a round Houſe of Stone: in the Brick Conduit is a Window; and in the round Houſe, a ſmall ſlit; ſo that when a Perſon hollows in the ſlit, it makes a fearful roaring at the Window. For all Concaves that proceed from narrow to broad, amplify the Sound at coming out.

In Hawks-Bells and Drums.

3. *Hawks-Bells*, that have Holes in the Sides, give a greater Ring, than if the Pellet ſtruck upon Braſs in the open Air. For the Sound incloſed by the ſides of the Bell, comes out at the Holes unſpent, and ſtronger. And in *Drums*, the cloſeneſs round about, that preſerves the Sound from diſperſing, makes the Noiſe come out at the Drum-holes, much louder and ſtronger, than if the like Skin were ſtruck, extended in the open Air.

Sounds heard farther by Night than by Day.

4. Sounds are heard better and farther in an Evening, or in the Night, than at Noon, or in the Day: becauſe in the Day, when the Air is thinner, the Sound pierces more; but when the Air is thicker, as in the Night, it ſpreads leſs: as being now in a degree of Encloſure. 'Tis true alſo, that the general ſilence of the Night contributes to this Effect.

Two kinds of Reflexion in Sounds.

5. There are two kinds of *Reflexion in Sound*; the one at a Diſtance, or the *Echo*; wherein the Original is heard diſtinctly, and the *Reflexion* alſo diſtinctly: the other in Concurrence; when the Sound reflecting near, returns immediately upon the Original, and ſo repeats it not, but amplifies. Whence Muſick upon the Water ſounds ſweeter; and better in Chambers that are wainſcotted, than ſuch as are hung [r].

The Advantage of Concavities and Sound-boards in Muſical Inſtruments.

6. The Strings of a *Lute*, *Viol*, or *Virginal*, give a much greater Sound, on account of the Knot and Concavity beneath, than if there were only a flat Board without that Hollow and Knot, by which the upper Air communicates with the lower. An *Iriſh Harp* admits the open Air on both ſides of the Strings: and its Belly runs not along with the Strings, but lies at the end of them. It makes a more reſonant Sound than the *Bandora*, *Orpharion*, or *Cittern*; tho theſe have Wire-ſtrings as well as that. The Cauſe ſeems to be, that the open Air on both Sides helps where there is a Concavity; which is therefore beſt placed at the End. A *Virginal*, when the Lid is down, makes a ſlenderer Sound than when the Lid is up: for all ſhutting in of Air, where there is no competent Vent, damps the Sound.

[r] Theſe Particulars deſerve to be compared with thoſe mentioned by the *Biſhop of Ferns*, in the Paper ſo often cited; which may ſhew upon what Foundation he proceeded to build his highly uſeful and extenſive *Doctrine of Acouſticks*.

The Obſervation transferred to the Structure of particular Places in Churches, &c.

7. There is a Church at *Glauceſter*, (and I have heard the like of other Places) where, if a Perſon ſpeaks ſoftly againſt a Wall; another ſhall hear his Voice better, at a conſiderable diſtance, than near at hand [v]: enquire more particularly of the Structure of that Place [u]. I ſuſpect there is ſome Vault, or Hollow, or Iſle, behind the Wall; and ſome Paſſage to it from the farther end of that Wall, againſt which the Perſon ſpeaks; ſo that the Voice ſlides along the Wall, then enters at ſome Paſſage, and communicates with the Air of the Hollow: for 'tis ſomewhat preſerved by the plain Wall; but that is too weak to give an audible Sound, till it has communicated with the back Air [w].

Inſtances to ſhew that Sounds communicate with the Spirits of Bodies.

8. Place the Horn of the Bow near your Ear, then touch the String, and the Sound will be increaſed to a degree of Tone: the *Senſory*, in this caſe, by reaſon of the near approach, being ſtruck before the Air diſperſes. The like happens, if the Horn be held betwixt the Teeth: but this is a plain Propagation of the Sound from the Teeth to the Organ of Hearing; for there is a great Intercouſe between theſe two Parts; as appears from hence, that a harſh, grating Tune ſets the Teeth on edge. The ſame thing happens if the Horn of the Bow be applied to the Temples; the Sound thus ſliding from thence to the Ear. If a Rod of Iron, or Braſs, be held with one end to the Ear, and the other be ſtruck upon, it makes a much greater Sound than the ſame Stroke upon the Rod, when not ſo contiguous to the Ear. By which, and other *Inſtances*, it ſhould ſeem that Sounds do not only ſlide upon the Surface of a ſmooth Body; but alſo communicate with the Spirits in the Pores of the Body [x].

Inſtances, ſhewing that Concavities magnify Sounds;

9. In *Trinity-College*, *Cambridge*, there was an upper Chamber, weak in the Roof, and therefore ſupported by an Iron Prop, as thick as a Man's Wriſt, placed in the middle of the Chamber: which Iron, if ſtruck, would make only a little flat Noiſe in the Room; but a great Bomb in the Chamber below. The Sounds made by Buckets in a Well, when they ſtrike againſt the Sides, or plunge into the Water, *&c.* are deeper and fuller than if the like Percuſſion were made in the open Air: on account of the Confinement and Incloſure of the Air in the Concave of the Well. So empty Barrels placed in a Room under a Chamber, make all the Sounds in the Chamber more full and reſounding. Hence there are *five general Ways of increaſing Sounds* [y]; *viz.* (1.) *ſimple Incloſure* [z]; (2.) *Incloſure with*

[v] On this Property of Sound, ariſing from the Structure of a Place, may depend the *Biſhop of Ferns*'s third and laſt *Problem*; viz. *To convey a Sound from one place to another, at a great diſtance; ſo as that it ſhall not be heard in the middle.*

[u] Conſider the Nature of *Whiſpering Galleries*, as, particularly, at St. *Paul's in London.*

[w] He who ſhall make himſelf Maſter of the Nature and Properties of Sounds, will, perhaps, have it in his power to perform as ſurprizing things as *Friar Bacon* is ſaid to have done, by his Skill in Opticks, and, probably, more ſerviceable

[x] Something to this Purpoſe was intimated above, *Sect.* II. 7.

[y] Obſerve, with regard to the *Method of the Enquiry*, the Uſe of particular *Inſtances* and *Experiments*; none of which are to be collected and made for their own ſakes, but to furniſh the Means of *Induction*, and *Axioms* that lead to capital Works.

[z] As in cylindrical Tubes.

with Dilatation[a]; (3.) *Communication*[b]; (4.) *Approach to the Senſory*[c]; and (5.) *concurrent Reflection*[d].

That Sounds paſs through both Solids and Fluids, but are thus rendered exile.

10. With regard to Exility of Sounds; 'tis certain the Voice paſſes through ſolid and hard Bodies, if they be not too thick; and again, through Water: but then the Voice is, by ſuch a Paſſage, reduced to a great Exility. Thus, if the Holes of a Hawk's Bell be ſtopped, it will not ring; but rattle like the Eagle-ſtone, which contains another Stone within it. And as for Water; take a Pail, turn the Bottom upward, and carry the Mouth of it down to the Level of the Water; plunge it ſix Inches deep, ſtill keeping it even, that it may not tilt on either ſide, and ſo the Air get out: then let a Perſon dive ſo far under Water, as to put his Head into the Pail; and there will come out as much Air in Bubbles as to make room for his Head. Now let him ſpeak, and his Voice will be heard plainly; tho now made extreme ſharp, like the Mock-voice of Puppets; yet the articulate Sounds of the Words will not be confounded. It may be more commodious to put the Pail over a Man's Head above Water; then, he ſinking down, to preſs the Pail down with him, ſo that by kneeling or ſitting, he may be lower than the Water.

Inſtances in muſical Strings, and metalline Veſſels ſtruck in Water.

11. In *Lutes*, and *ſtringed Inſtruments*, if you ſtop a String high, whereby it has leſs ſcope to tremble, the Sound is more treble, but more dead. Take two Saucers, and ſtrike the Edge of the one againſt the Bottom of the other, within a Pail of Water; and as you put the Saucers lower and lower, the Sound will grow flatter, even while part of the Saucer is above the Water; but that flatneſs of Sound is joined with a harſhneſs, cauſed by its Inequality; as coming from the parts of the Saucer that are under the Water. But when the Saucer is wholly under the Water, the Sound becomes clearer, tho much lower; as if it came from afar.

That ſoft Bodies deaden Sounds more than hard ones.

12. Soft Bodies damp Sound much more than hard ones. Thus, if a Bell be wrapped round with Cloth or Silk; it deadens the Sound more than if the Bell were ſurrounded with Wood. Trial was made in a *Recorder*, and varied ſeveral Ways: the Bottom of it was ſtopped, (1.) with Wax; (2.) ſet againſt the Palm of the Hand; (3.) againſt a Damaſk Cuſhion; (4.) placed in Sand; (5.) placed in Aſhes; and, (6.) ſet half an Inch deep in Water, cloſe to the Bottom of a Silver Baſon; and ſtill the Tone remained: but when the Bottom of it was ſet againſt, (1.) a woollen Carpet; (2.) a pluſh Lining; (3.) a Lock of Wool, tho looſe; and, (4.) againſt Snow; the Sound of it was quite deadned, and no more than a Breath.

Extended to Iron and Water, hot and cold.

13. Hot *Iron* produces not ſo good a Sound as cold; for, while hot, it appears to be more ſoft, and leſs reſounding. So likewiſe, warm Water in falling, makes not ſo full a Sound as cold; being, I conceive, ſofter, and nearer the nature of Oil; for 'tis more ſlippery, and ſcowers better.

[a] As in ſpeaking *Trumpets*, &c.
[b] As in *Harps*, &c. where the Air communicates on both ſides.
[c] As when the Ear is cloſe applied to the ſounding Body.
[d] As in ſpeaking near hollow Veſſels, *&c.* Could not various particular Methods, capable of producing great Effects, be found, by an artificial Application, or Combination, of two, or more of theſe?

Two Experiments of Light directed.

14. Let a *Recorder* be made with two Fipples, at each end one; the Trunk as long as two Recorders, and the Holes anſwerable towards each End: let two Perſons play the ſame Leſſon upon it in Uniſon; and obſerve whether the Sound be confounded, or augmented, or deadned. So likewiſe, let a Croſs be made of two hollow Trunks; and let two Perſons ſpeak, or ſing; the one lengthwiſe, the other tranſverſe: and let there be two Hearers at the oppoſite Ends; to obſerve whether the Sound be confounded, augmented, or deadned. Theſe two *Inſtances* will alſo give light to the mixture of Sounds *.

Bellows applied to the Hole of a Drum.

15. Bellows being blown in at the Hole of a Drum, whilſt the Drum beats, makes it ſound a little flatter, without any other apparent Alteration. The *Cauſe* is, that the Bellows in part prevent the iſſuing of the Sound; and in part alſo make the Air leſs moveable.

SECT. IV.

Of the Loudneſs or Softneſs of Sounds, and their Propagation to Longer or Shorter Diſtances.

The ſtrength of Percuſſion, a principal Cauſe of the Loudneſs and Softneſs of Sounds.

1. THE *Loudneſs* and *Softneſs* of Sounds, is a thing diſtinct from their Magnitude and Exility; for a baſs String, tho gently ſtruck, gives the greater Sound; but a treble String, if hard ſtruck, will be heard much farther: becauſe the baſs String ſtrikes more Air, and the treble leſs, but ſharper. The ſtrength of Percuſſion is, therefore, a principal *Cauſe* of the loudneſs and ſoftneſs of Sounds; as in knocking harder or ſofter; winding a Horn ſtronger or weaker, *&c.* And the ſtrength of this Percuſſion conſiſts as much in the hardneſs of the Body ſtruck, as in the force of the ſtriking Body: for if you ſtrike Cloth, it gives a leſs Sound; if, with the ſame force, Wood, a greater; if Metal, a ſtill greater. And, in Metals, Gold gives the flatter Sound; and Silver, or Braſs, the more ringing Sound. But Air, where ſtrongly confined, reſembles a hard Body: whence the loud Noiſe in diſcharging a Cannon. We find alſo, that a Charge, whether with Bullet, or Paper, wet and hard ſtopped, or with Powder alone, rammed hard, makes no great difference in the loudneſs of the Report.

Sharpneſs of Percuſſion, a Cauſe of loudneſs and ſtrength in Sounds.

2. The ſharpneſs or quickneſs of the Percuſſion, is a great cauſe of the loudneſs, as well as the ſtrength. So if you ſtrike the Air with a Whip, or a Wand, the ſharper and quicker it is done, the louder Sound it makes. And in playing upon the *Lute*, or *Virginal*, the quick Touch adds great life

* Perhaps theſe two Experiments have not hitherto been tried; at leaſt, I have not met with them in any other Author; tho, poſſibly, the Biſhop of *Ferns* knew their Succeſs; if we may conjecture from his Intimation of an uncommon Method of mixing Sounds, and making a *Conſort* with a ſingle Inſtrument. Let the Nature and Application of *echoing* and *whiſpering Places*, be conſidered upon this Occaſion. But, for the Mixture of Sounds, ſee more hereafter, *Sect.* XVI.

life to the Sound: the quick Stroke cutting the Air ſuddenly; whilſt the ſoft one rather beats than cuts it [f].

SECT. V.

Of the Communication of Sounds.

1. AN apt Experiment for demonſtrating the *Communication* of Sounds, is the chiming of Bells; for if you ſtrike with a Hammer, firſt upon the upper part of the Bell, then upon the middle, and laſtly upon the lower part; you will find the Sound to be more treble or more baſs, according to the Concavity on the inſide; tho the Percuſſion be only on the outſide. *That Sounds communicate, ſhewn in Bells.*

2. When the *Sound* in Wind-Inſtruments is produced between the Blaſt of the Mouth, and the Air of the Inſtrument, it has yet ſome *Communication* with the Matter of the Sides of the Inſtrument, and the Spirits therein contained; for in a Flute, or Trumpet of Wood and another Braſs, the Sound will be different: ſo if the Flute be covered with Cloth or Silk, it gives a different Sound from what it would do of itſelf; and if the Flute be a little wet on the inſide, it will make a different Sound from the ſame Flute dry [g]. *And in wooden Inſtruments.*

SECT. VI.

Of the Equality and Inequality of Sounds.

1. WE come next to ſuch *Inequality of Sounds* as proceeds, not from the nature of the Bodies themſelves, but is accidental; either through the roughneſs or obliquity of the Paſſage, the doubling of the Percutient, or the trepidation of the Motion. A Bell if crack'd, whereby the Sound has not a clear Paſſage, rings hoarſe and jarring; ſo the human Voice, becomes hoarſe, when by a Cold the Wind-pipe grows rugged and furred. And in theſe two *Inſtances* the Sounds are ungrateful, becauſe totally unequal; but when unequal in Equality, they prove grateful, tho purling. *The Inequality of Sounds in crack'd Bells; and hoarſe Voices.*

2. All Inſtruments that have either Returns, as *Trumpets*; Flexures, as *Cornets*; or are elevated and depreſſed, as *Sackbuts*; yield a purling Sound: but the Flute, that has none of theſe Inequalities, gives a clear Sound. Yet the *Flute* itſelf moiſtened a little on the inſide, ſounds more ſolemnly, and with *That Inſtruments have different Sounds according to their Figures.*

[f] See this *Article* farther proſecuted in Mr. *Malcolm's Treatiſe of Muſick*, CHAP. I. and *M. Perault's Eſſais du Bruit.* There are alſo certain Papers in the *Philoſophical Tranſactions*, and *French Memoirs*, that give light to this Subject.

[g] Some Particulars relating to this *Article*, have been already treated occaſionally, under *Sect.* III.

with a degree of purling or hiſſing. And a wreathed String, ſuch as the baſs Strings of a *Bandora*, alſo yields a purling Sound.

The Obſervation extended to muſical Strings.

3. But a *Lute String*, if it be altogether unequal in its Parts, gives a harſh and untuneable Sound; which kind of Strings we call *falſe Strings*, as being bigger in one part than another: whence Wire-ſtrings are never falſe. So, to try a *Lute String*, we extend it hard between the Fingers, and fillip it; and if it give a double Species, it is *true*; but if more, it is *falſe* [h].

Inſtances where Water gives a purling Sound.

4. The running of Waters affords a trembling Noiſe; and in *Regals*, which have a Nightingal-pipe that contains Water, the Sound is continually tremulous. There is alſo a Play-thing for Children called *Cocks* [i], with Water in them; which, when blown into, yield a trembling Sound: and this trembling of Water has an Affinity with the Letter *L*. And all theſe Inequalities of Trepidation are rather pleaſant than otherwiſe.

Why the Tenor is the ſweeteſt part in Muſick.

5. All baſs, or very treble Notes, give a rough Sound; the Baſs ſtriking more Air than it can well ſtrike equally: whilſt the Treble cuts the Air ſo ſharp, that it returns too ſwift to make the Sound equal; and therefore the Mean, or Tenor, is the ſweeteſt Part in Muſick.

Why no voluntary Motion but the Voice, makes a muſical, or immuſical Sound, at pleaſure.

6. We know nothing that can, at pleaſure, make a muſical or immuſical Sound, by voluntary Motion, but the Voice of Man and Birds. The *Cauſe* is, no doubt, in the Wind-pipe; which, being well extended, acquires an Equality; as a Bladder that is wrinkled, becomes ſmooth when extended [k]. The Extenſion is always greater in Tones than in Speech; whence the inward Voice, or Whiſper, can never give a Tone. And in ſinging, there is a greater Labour of the Throat than in ſpeaking; as appears from the thruſting out, or drawing in of the Chin, when we ſing. The humming of Bees is an unequal Buzzing, conceived, by ſome of the Ancients, not to iſſue at the Mouth of the Creature; but to be an inward Sound. It ſhould rather ſeem to proceed from the motion of their Wings; for it is not heard but when theſe ſtir.

The Sound of Metals quenched in Water.

7. All Metals quenched in Water give a hiſſing Sound; (which has an Affinity with the Letter *Z*;) notwithſtanding the Sound is created between the Water, or Vapour, and the Air. Boiling alſo, if there be but little Water in a Veſſel, makes a hiſſing Sound; but boiling in a full Veſſel makes a bubbling Sound, ſomewhat like that of the *Cocks* uſed by Children [l].

Experiments recommended for trying the Effects of unequal Mediums upon Sound.

8. Trial ſhould be made, whether the Inequality of the Medium will not produce an Inequality of Sound; as if three Bells were made, one within an-

[h] I ſuppoſe this double *Species* is meant of the two *Senſations*, or *Sounds*, cauſed by the going, and returning of the String; which Sounds will only be uniform, or equable, when the String is of the ſame Thickneſs in all the vibrating Parts.

[i] The Thing here meant, ſeems at preſent to be out of Uſe: 'tis a kind of *Bellied-Whiſtle*, made of *Earthen-Ware*, and filled with Water up to the Whiſtle-part; whereat, when a Perſon blows, it yields a ſhrill, or very ſharp Sound, with a conſiderable degree of Purling. By *Purling*, is underſtood, what may be otherwiſe called the *Jug*, or *quick Double*; as in the Singing of the Nightingal, the Playing of a *Flagellet*, &c.

[k] There is a curious Paper to this Purpoſe in the *French Memoirs*.

[l] See above, § 4.

another, with Air between them; and the outermoſt Bell were chimed with a Hammer; how would the Sound differ from that of a ſingle Bell? So, likewiſe, join a Plate of Braſs, and a Plank of Wood together; and ſtrike upon one of them, to try if they do not give an unequal Sound. Again, make two or three Partitions of Wood in a Hogſhead, with Holes or Knots in them; and mark the difference of their Sound from that of a Hogſhead without ſuch Partitions [m].

SECT. VII.

Of the more Treble, and the more Baſs Tones, or muſical Sounds.

1. 'TIS evident that the Percuſſion of a greater Quantity of Air, cauſes the *Baſs Sound*; and the leſs Quantity, the *Treble*. The Percuſſion of the greater Quantity of Air, proceeds from the largeneſs of the ſtriking Body; and the length and breadth of the Concavity through which the Sound paſſes: whence a baſs String is greater; a baſs Flute, wider than a treble; and in *Pipes*, and the like, the lower the Note-holes are, and the farther from the Mouth of the Pipe, the more baſs the Sound; and the nearer the Mouth, the more treble: ſo, if you ſtrike an entire Body, as an Andiron of Braſs, at the Top; it makes a more treble Sound; and at the Bottom, a more baſs. 'Tis alſo evident, that the ſharper or quicker Percuſſion of the Air, cauſes the more treble Sound; and a ſlower, or heavier, the more baſs Sound. So in Strings, the more they are ſtrained, the quicker they ſtart back, and the more treble the Sound; as, on the contrary, the ſlacker they are, the baſer the Sound: and hence, a bigger String more ſtretched, and a ſmaller String leſs ſtretched, may fall into the ſame Tone. *The Cauſe of Baſs and Treble Sounds.*

2. Children, Women, and Eunuchs, have ſmaller, and ſhriller Voices than Men: not becauſe Men have greater Heat, which may make the Voice ſtronger (for ſtrength of Voice regards only loudneſs and ſoftneſs, not *Tone*;) but from the Dilatation of the Organ; which, indeed, may proceed from Heat. But the *Cauſe* of changing in the Voice, at the Years of Puberty, is more obſcure. It ſeems to be hence, that when much of the moiſture of the Body, which before watered the Parts, is drawn down to the ſpermatick Veſſels, it leaves the Body hotter; whence the Dilatation of the Organs [n]: for *The Cauſe of breaking in the Voice.*

[m] He who deſires to improve the preſent Set of *Muſical Inſtruments*, or to invent new ones, with Advantages wanting in the preſent, ſhould apply to the making of theſe kinds of *Experiments*; without which, no juſt *Axioms* in Phyſicks, capable of directing the *Inſtrument-maker*, can be procured.

[n] *Viz.* the *Aſpera Arteria*, or the Head of the *Larynx*, &c. and we certainly know that Heat has the Power of dilating, or expanding all the parts of the Body; as well as rendering them dry. And, doubtleſs, theſe two Properties have a Power of altering Sounds, as all Inſtances confirm. However, the Point ſhould be more accurately examined by *philoſophical Anatomiſts*.

for all the Effects of Heat manifeſtly come on at this time; as Piloſity, roughneſs of the Skin, hardneſs of the Fleſh, &c.

Three Ways of ſtraining muſical Strings.

3. The Induſtry of Muſicians has invented two other Ways of ſtraining Strings, beſides winding: the one is, ſtopping them with the Finger; as in the Necks of *Lutes*, *Viols*, &c. the other is, by ſhortening the Strings; as in *Harps*, *Virginals*, &c. Both theſe depend upon the ſame Principle; as they only cauſe the String to give a quicker Start. In ſtraining of a String, the farther it is ſtretched the leſs ſuper-ſtraining goes to a Note; for a String requires to be conſiderably wound, before it will make any Note at all: and in the Stops of Lutes, &c. the higher they go, the leſs diſtance there is between the Frets.

The Tone of Drinking-glaſſes varies with the Quantity of Water in them.

4. If you fill a conical Drinking-glaſs with Water, then fillip it on the Brim, and afterwards empty part of the Water, and ſo more and more; ſtill trying the Tone by fillipping; you will find the Tone more baſs, as the Glaſs grows more empty.

SECT. VIII.

Of the Proportion of Treble and Baſs Tones.

How to diſcover the Proportion of Air ſtruck, in treble and baſs Tones.

1. THE juſt, and meaſured Proportion of the Air ſtruck, with regard to the baſeneſs, or trebleneſs of Tones, is one of the greateſt Secrets in the contemplation of Sounds: for it diſcovers the true coincidence of Tones into *Diapaſons*; which is the Return of the ſame Sound: and ſo of the Concords and Diſcords between the *Uniſon* and the *Diapaſon*. This may be diſcovered, (1.) in the Proportion of the winding of Strings; (2.) in the Proportion of the diſtance of Frets; and, (3.) in the Proportion of the concavities of Pipes, &c. but more commodiouſly in the laſt.

Viz. (1.) By the winding of Strings.

2. But firſt try the winding of a String once about, as ſoon as it is brought to that Extenſion as to give a Tone; then twice about, thrice, &c. and mark the Scale, or difference of the Riſe of the Tone: whereby you will, at once, diſcover two Effects, or the Proportion of the Sound, in reſpect to the Winding; and the Proportion of the Sound, in reſpect of the String, as it is more or leſs ſtrained: but to meaſure this; the Way will be, to take the length in a right Line of the String, upon any winding about of the Peg.

(2.) By the diſtance of Frets.

3. As for the *Stops*: take the number of Frets; and, principally, the length of the Line from the firſt Stop of the String, to ſuch a Stop as ſhall produce a *Diapaſon* to the former, upon the ſame String.

(3.) By the Bores of Pipes.

4. But, as we before obſerved, the thing will beſt appear in the Bores of Wind-inſtruments: let, therefore, ſix Pipes be made alike, in length and all things elſe; only with a ſingle, double, and ſo on to a ſextuple Bore; and mark what fall of Tone every one gives. But in theſe three *Inſtances* it

muſt

muſt be diligently obſerved, what length of String, diſtance of Stop, and concavity of Inſtrument, gives what riſe of Sound: thus, in the laſt caſe, you muſt ſet down what increaſe of Concavity goes to the making of a Note higher, what of two Notes, what of three; and ſo up to the *Diapaſon:* for then the great Secret of Numbers and Proportions will appear. Perhaps the Makers of Wind-inſtruments know this already; becauſe they make them in Sets: and likewiſe Bell-founders, in adjuſting the Tune of their Bells: ſo that Enquiry may here ſave Trial [l].

5. 'Tis obſerved by one of the Ancients, that an empty Barrel ſtruck with the Finger, gives a *Diapaſon* to the Sound of the like Barrel when full; but how that ſhould be, I do not well underſtand; becauſe the ſtriking of a Barrel, full or empty, ſcarce gives any Tone [m]. *Whether the Sound of an empty Veſſel, be the Diapaſon to that of the ſame Veſſel, when full.*

6. Some ſenſible difference is required in the Proportion of creating a Note, with regard to the Sound itſelf, which is paſſive; and that it be not too near, but at a diſtance: for in a Recorder, the three uppermoſt Holes yield one Tone; which is a Note lower than the Tone of the firſt three: and the like, no doubt, is required in the winding or ſtopping of Strings [n]. *The Creation of a Note requires a ſenſible difference from the Sound.*

SECT. IX.

Of External and Internal Sounds.

1. THere is another difference of Sounds, which we call *external* and *internal.* This is neither ſoft nor loud, baſs nor treble; muſical nor immuſical: and tho there can be no Tone in an external Sound; yet it may be both *muſical* and *immuſical.* The *internal Sound* we mean, is rather an *Impulſe*, or *Contruſion*; than an *Eliſion*, or cutting of the Air: ſo that the Percuſſion of the one, with regard to the other, differs as a Blow does from a Cut. In Speech, the Whiſper, whether loud or ſoft, is an internal; but ſpeaking out, an external Sound: whence we can never make a Tone, nor ſing in Whiſper; but in Speech we may. So Breathing, or blowing by the Mouth, Bellows, or Wind, tho loud, is an internal Sound; but the blowing through a Pipe, or Concavity, is an external one. So, likewiſe, the greateſt Winds, if they have no Coarctation, or blow not hollow, give an internal Sound; but the whiſtling, or hollow Wind, yields a ſinging, or external Sound; the former being confined by ſome other Body; and the latter, confined by its own Denſity: and therefore when the *The Notion of an internal Sound illuſtrated.*

[l] It ſhould ſeem, that the Makers of Wind-inſtruments, and Bell-founders, have no exact Rule for this Purpoſe; or elſe no true Method of obſerving it: they, however, come tolerably near, by Habit and Practice, as it were mechanically; and afterwards by making ſome ſmall Alterations, as *ſcraping* the Pipe, or *chipping* the Bell, bring the Tone to a Truth.

[m] Perhaps the Veſſel was not of Wood, but Metal. How does the thing ſucceed in Glaſs? See above, *Sect.* VII. 4.

[n] There ſeems to be ſomething intimated here, with regard to the Creation of *Notes*, that has not hitherto been clearly and phyſically made out.

Wind blows hollow, 'tis a ſign of Rain. So Flame, as it moves within itſelf, or is blown by Bellows, gives a Murmur, or internal Sound.

External and internal Sounds differently produced.

2. There is no hard Body, but when ſtruck againſt another hard Body, will yield an external Sound, greater or leſs: inſomuch, that if the Percuſſion be over-ſoft, it may induce a Nullity of Sound; but never an internal Sound: as when one treads ſo ſoftly as not to be heard. Where the Air, whether confined or not confined, is the Percutient againſt a hard Body, it never gives an external Sound; as in blowing ſtrongly with Bellows againſt a Wall. Sounds, both external and internal, may be made, as well by Suction as by Emiſſion of the Breath: as in Whiſtling or Breathing [p].

SECT. X.

Of the Articulation of Sounds.

That Sounds are not only in the whole, but alſo in ſmall parts of the Air.

1. 'TIS one of the greateſt Myſteries in Sounds, that the whole Sound is not only in the whole Air; but the whole Sound is alſo in every ſmall part of the Air: ſo that all the curious diverſity of articulate Sounds, as in the Voice of a Man or Birds, will enter at a ſmall Chink, without Confuſion.

That unequal Agitation does not confound the Articulation of Sounds.

2. The unequal Agitation of the Winds, or the like, tho it promotes the Conveyance of Sounds; yet does not confound their Articulation, within the Diſtance they can be heard to: tho it may cauſe them to be heard the leſs way [q].

Great Diſtance confounds Sounds.

3. Too great Diſtance confounds the Articulation of Sounds: thus we may hear the Sound of a Preacher's Voice, when we cannot diſtinguiſh what he ſays. And one articulate Sound will confound another; as when many ſpeak at once.

That Loudneſs and Lowneſs in Exceſs confounds Articulation.

4. In ſpeaking under Water, when the Voice is reduced to an extreme Exility [r]; yet the articulate Sounds, that is the Words, are not confounded. I conceive, that an extreme ſmall, or an extreme great Sound, cannot be articulate; but that Articulation requires a mediocrity of Sound: as the extreme ſmall Sound confounds the Articulation by contracting; and the large one by diſperſing. And tho an articulate Sound already created, will be contracted into a ſmall Compaſs, and paſs thro' a narrow Chink; yet the firſt Articulation requires a greater Dimenſion.

Vaulting above and below hinders Articulation.

5. It has been obſerved, that in a Room, or Chappel, vaulted below and above, a Preacher cannot be heard ſo well, as in the like places, not ſo vaulted. For in this Caſe the ſubſequent words come on, before the precedent ones vaniſh: and therefore the articulate Sounds are more confuſed, tho the groſs of the Sound be greater.

6. The

[p] This *Article* remains conſiderably defective.

[q] See Mr. *Derham's* Latin Paper upon the *Motion of Sounds*, in the *Philoſophical Tranſactions*, N° 313.

[r] See above, SECT. III. 10.

6. The Motions of the Tongue, Lips, Throat, Palate, &c. which go to make the ſeveral *Alphabetical Letters*, relate to the *Enquiry of Sounds*. The *Hebrews* have been diligent herein: and determined which Letters are labial, dental, guttural, &c. The *Latins* and *Grecians* have diſtinguiſh'd between *Semi-Vowels* and *Mutes*; and in *Mutes* tolerably well between *mutæ tenues*, *mediæ* & *aſpiratæ*: tho not with Diligence. For, they have little examined the particular Percuſſions and Motions that create thoſe Sounds: as that the Letters, B, P, F, M, are not expreſſed, but with contracting or ſhutting the Mouth; that the Letters N and B, cannot be pronounced together, without the Letter N turning into M: As *Hecatonba* will become *Hecatomba:* That M and T cannot be pronounced together, but P will come between them; as *Emtus* is pronounced *Emptus:* and there are many of the like Inſtances. So that whoever enquires to the full, will find, there are fewer ſimple Motions required, to the making of the whole Alphabet, than there are Letters [r]. *The Motions of the Organs of Speech in expreſſing the Letters.*

7. The *Lungs* are the moſt ſpungy Part of the Body, and therefore ableſt to contract and dilate; and when they contract, they expel the Air; which paſſing thro' the *Aſpera Arteria*, Throat, and Mouth, makes the Voice: but Articulation is not produced without the help of the Tongue, the Palate, and the reſt of thoſe call'd the Organs of Speech. *The Voice and Articulation, how form'd.*

8. There is a Similitude between the Sound made by inanimate Bodies, or animate Bodies that have no articulate Voice; and ſeveral Letters of articulate Voices: and Men have commonly given ſuch Names to theſe Sounds, as allude to the articulate Letters. Thus the trembling Sound of Water bears a reſemblance to the Letter L; the quenching of hot Metals, in Water, to the Letter Z; the ſnarling of Dogs, to the Letter R; the Voice of Screech-Owls, to the Letters *Sh*; the Voice of Cats, to the Dipthong *Eu*; the *Voice* of Cuckows, to the Dipthong *Ou*; the Sounds of Strings, to the Letters *Ng*. So that for Inſtance, to make an inanimate Body pronounce a word; the Motion of the Inſtruments of the Voice muſt be conſider'd, on the one ſide; and the like Sounds made in inanimate Bodies, on the other; and what Conformity cauſes the Similitude of Sounds [t]. *Intimations for making inanimate Things ſpeak.*

[r] This is a curious Part of the *Enquiry*, and of large Extent; which ſome make a part of *Grammar* or *Speech:* tho it requires a *Phyſical Conſideration.* Let Dr. *Holder*, Dr. *Wallis*, M. *Amman*, the *Philoſophical Tranſactions*, and the *French Memoirs*, be conſulted upon this occaſion.

[t] Were it not hence eaſy to make a *Dog*, a *Cat*, or other Creature pronounce certain Words diſtinctly? And is there any other Secret in the accounts we have had of *Speaking Dogs*, than that the Maſter knew how to make them *growl*, or *howl* in one continued Tone, whilſt he modulated the Sound with his Hand, by directing the Motion of the Dog's Mouth, ſo as to render the Voice articulate? And if this general *Enquiry* were to be duly proſecuted, no doubt, but even inanimate Bodies, however ſtrange it may ſeem, might be made to ſpeak certain Words. And whoever ſhal thoroughly underſtand the Nature of Sounds, will be able to do much greater Things than theſe. For ſuch Things only appear ſtrange thro' our own Ignorance.

SECT. XI.

Of the Direction of Sounds.

That Sounds move every way, and not neceſſarily in a ſtrait Line.

1. SOunds move in a Sphere; that is, every way; upwards, downwads, forwards and backwards; as appears in all Inſtances. Sounds do not, like the Rays of Light, require to be convey'd to the Senſe in right Lines; tho they move ſtrongeſt in a right Line: becauſe ſuch a Line is the ſhorteſt Diſtance. Hence, a Voice on one ſide of a Wall is heard on the other: not becauſe the Sound paſſes thro' the Wall; but Arch-wiſe over it.

Sounds when ſtopped go round.

2. If a Sound be ſtopp'd, and repell'd, it goes round on the other ſide; in an oblique Line. Thus, if a Bell be rung on the North ſide of a Chamber, and the Window of that Chamber open to the South; a Perſon within the Chamber would think the Sound came from the South: and the Caſe is the ſame in a Coach, *&c.*

Sounds go fartheſt in the front Lines to the ſounding Body.

3. Sounds, tho they move in a Sphere, yet are ſtrongeſt, and go fartheſt in the Front-Lines, from the firſt impulſe of the Air: and therefore, in preaching, the Voice is better heard before the Pulpit, than behind it, or on the ſides; tho it ſtand open. So a piece of Ordnance will be farther heard forward from the mouth of the Piece, than behind, or on the ſides [a].

Whether Sounds move better downwards or upwards.

4. It may be ſuſpected, that Sounds move better downwards than upwards. Pulpits are placed high above the People: and when the ancient Generals harangued their Armies, they had always a Mount caſt up, for them to ſtand upon. But this may be imputed to the Stops and Obſtacles, which the Voice meets with, in ſpeaking on a Level. Yet there ſeems to be ſomewhat more in it; for perhaps *ſpiritual Species*, both viſible and audible, move better downwards than upwards [y]. 'Tis ſtrange, that to Men ſtanding upon the Ground, others on the top of St. *Paul*'s, ſeem not only much leſs, but cannot be known; whilſt to thoſe above, the Perſons below ſeem not ſo little, and may be known; tho all other Things to them above, ſeem ſomewhat contracted, and better defined, or collected into Figures [w]. So Knots in Gardens ſhew beſt from an upper Window or Terras. But to make an exact Trial, with regard to Sound, let a Man ſtand in a Chamber not much above the Ground [z]; and ſpeak out at the Window thro' a Trunk, as ſoftly as he can, to one ſtanding on the Ground; the other laying his

[a] See Mr. *Derham's Experiments*, in the *Philoſophical Tranſactions*.

[y] This may hold true of Sounds, becauſe of the greater Denſity of the Air below than above: but will it hold true of Viſion, for the ſame Reaſon?

[w] Is the Obſervation verified?

[z] Why ſhould not the Experiment be tried at a greater height from the Ground; if a long Tube were procurable? What is the common Obſervation of Maſons, working on the top of a Steeple, and converſing with others below?

his Ear close to the Trunk: then let the Person below speak, in the same degree of Softness; and let him in the Chamber lay his Ear to the Trunk: and this may be a proper means to judge whether Sounds descend or ascend the better.

SECT. XII.

Of the Duration of Sounds; and the time they require in their Generation, or Propagation.

The Continuance and melting of Sounds, whence.

1. AFTER Sound is created, as it is in a moment, we find it continues some small time, melting by degrees. And here a great Error has prevailed, in taking this to be a continuance of the first Sound; whereas it is a Renovation: For the Body struck has a Trepidation wrought in the minute Parts; and so renews the Percussion of the Air. This is evident; because the melting Sound of a Bell, or String, ceases as soon as the Bell or String is touch'd. And here are two Trepidations to be distinguished: the one manifest and local; as of the Bell when it is pensile: the other secret, and of the minute Parts [y]: yet the local greatly helps the secret one. So likewise in Pipes, and other Wind-Instruments, the Sound lasts no longer than the Breath blows. 'Tis true, that in Organs there is a confused Murmur for a small time after; but this is only while the Bellows are falling.

The Motion of Sounds.

2. 'Tis certain, that the Report of Ordnance, where many are fired together, will be carried above twenty Miles by Land; and much farther by Water: but then it comes to the Ear, not in the instant of shooting; but perhaps an Hour or more after [z]: which must needs be a continuance of the first Sound: for there is no Trepidation to renew it. And the touching of the Ordnance wou'd not extinguish the Sound the sooner: so that in greater Sounds, the continuance is more than momentary.

An Experiment for determining the Velocity of Sound.

3. To try exactly the time wherein Sound is propagated; let a Man stand in a Steeple, with a Taper, veiled; and let another Man stand a Mile off: then let the Person in the Steeple strike a Bell; and at the same Instant withdraw the Veil or Blind, that the other at a Distance may measure the Time between the Light seen, and the Sound heard: for Light is propagated instantaneously [a]. This may be tried in far greater Distances; allowing greater Lights and Sounds.

4. 'Tis

[y] This Distinction is made great Use of by M. *Perault*, in his *Essais du Bruit.*

[z] The *Velocity of Sound* is somewhat differently computed by different Authors: According to Mr. *Boyle* it moves 1200 *English Feet* in a Second; and according to Dr. *Halley* 1142. See *Newton. Princip.* Lib. II. Prop. 50. And again, Mr. *Derham's* Paper in the *Philosophical Transactions*, N° 313.

[a] Or what comes very near thereto: for in the space of seven or eight Minutes, it is thought by some to travel from the Sun to the Earth. See *Newton. Princip.* Lib. II. Prop. 96. *Schol.*

That Sound moves ſlower than Light.

4. 'Tis generally obſerved, that Light moves ſwifter than Sound; for the flaſh of a Musket is ſeen ſooner than the Report is heard. And in the hewing of Wood, we may ſee at ſome Diſtance, the Arm lifted up for a ſecond Stroak, before we hear the Sound of the firſt. And the greater the Diſtance, the greater is the Anticipation: as in Thunder afar off; when the Lightning long precedes the Crack [b].

The difference betwixt Sounds and Colours as to melting away.

5. Colours repreſented to the Eye, neither fade, nor melt by degrees; but appear ſtill in the ſame ſtrength; whilſt Sounds melt and vaniſh by little and little: for Colours participate not of the Motion of the Air; as Sounds do. And 'tis manifeſt that Sound participates of ſome local Motion of the Air; becauſe it periſhes ſo ſuddenly: for in every Diviſion or Impulſe of the Air, the Air ſuddenly reſtores and re-unites itſelf; which Water alſo does, tho not ſo ſwiftly.

SECT. XIII.

Of the Paſſage and Interception of Sounds.

Cautions required in making Experiments about the Paſſage of Sounds.

1. IN Experiments of the Paſſage, or Reſiſtance of Sounds, care muſt be had not to miſtake the paſſing along the Sides of a Body, for the paſſing thro' a Body: and therefore the intercepting Body ſhould be very cloſe; for Sound will paſs thro' a ſmall Chink. But when the Sound is to paſs thro' a hard or cloſe Body; as a Wall, Metal, Water, *&c.* the Body muſt be but thin and ſmall; otherwiſe it utterly damps the Sound: whence in the Experiment of ſpeaking under Water, the Voice muſt not be very deep within the Water; for then the Sound would not penetrate thro'.

That the pneumatical Parts of ſounding Bodies co-operate moſt when the ſides are ſtruck.

2. 'Tis certain, that in the paſſage of Sounds thro' hard Bodies, the Spirit or pneumatical part of the Body itſelf, co-operates [c]; but much better when the Sides of the hard Body are ſtruck, than when the Percuſſion is only internal, without touching the Sides. Take, therefore, a Hawk's Bell, with the Holes ſtopped up; and hang it, by a Wire, within a Glaſs Bottle; cloſe the mouth of the Glaſs with Wax; then ſhake the Glaſs, and try whether the Bell will give any Sound, or how weak [d].

Sounds differently damped by different Arches.

3. 'Tis certain, that a very wide Arch deſcending ſharp, will quite extinguiſh Sounds; ſo that the Sound which would be heard over a Wall, cannot be heard over a Church; nor the Sound, audible at ſome Diſtance from a Wall, be heard cloſe under the Wall.

4. Soft

[b] On this Foundation the Diſtance of Exploſions, Thunder, *&c.* may be readily known; by counting the Seconds that paſs betwixt the Flaſh and the Report. See the *Note* to § 2. above.

[c] This is more fully inſiſted upon above, *Sect.* III. 8.

[d] The Invention of the *Air-Pump* and *Condenſor* has render'd numerous Experiments, with Relation to *Sounds* and *Hearing*, much more commodiouſly practicable, than they could have been without it. But Philoſophers ſeem weary of theſe new *Engines*, already; before half their Uſes are known.

4. Soft and foraminous Bodies will deaden Sounds in their firſt Creation; for the ſtriking againſt Cloth or Fur makes little Sound; but in its Paſſage, they admit it better than harder Bodies: ſo Curtains and Hangings do not ſtop a Sound much; but Glaſs Windows, if very cloſe, will check it more than the like thickneſs of Cloth. *Soft Bodies damp Sounds in their firſt Production.*

5. 'Tis worth enquiring, whether great Sounds do not become more weak and exile, in paſſing thro' ſmall Chinks: for the ſubtilties of articulate Sounds may perhaps paſs them unconfuſed; but magnitude of Sound not ſo well [e]. *Whether large Sounds are damp'd by going thro' ſtrait Paſſages.*

SECT. XIV.

Of the Medium of Sounds.

1. THE *Mediums* of Sounds are *Air*, *Water*, ſoft and porous Bodies; and in ſome degree alſo, hard ones: but all of them are dull and unapt, except the *Air*. The thinner Air does not convey Sound ſo well as the denſer. This appears from Sounds in the Night and Evening; in moiſt Weather, and in Southern Winds: for thin Air is better penetrated; whilſt a thick Air better preſerves the Sound from waſte. But let farther Trial be made, by hollowing in Miſts and gentle Showers: for Dampneſs, perhaps, will ſomewhat deaden the Sound [f]. *Air the beſt adapted Medium of Sound.*

2. How far Flame may be a Medium of Sounds; eſpecially ſuch as are created by Air, and not betwixt hard Bodies; may be tried by ſpeaking where a Bonfire is between: but then allowance muſt be made for ſome diſturbance in the Sound, cauſed by that of the Flame itſelf. *Whether Flame be a Medium of Sound.*

3. Whether any other Fluids, being uſed as Mediums, propagate Sound differently from Water, may be eaſily tried; as by ſtriking the bottom of a Veſſel, fill'd either with Milk, or Oil; which, tho more light, are more unequal Bodies than Water [g]. *Whether other Fluids propagate Sounds differently from Water.*

SECT. XV.

Of the Figures of the Concaves, or Bodies, thro' which Sounds are convey'd.

1. THE Figure of a Bell partakes of the inverted, truncate Pyramid; but comes off and dilates more ſuddenly. The Figure of the Huntſman's Horn, and Cornet, is oblique; tho there are likewiſe ſtrait Horns; which if of the ſame Bore with the crooked ones, differ little in Sound; tho

[e] See *Sect.* X. 4, 5.
[f] See Mr. *Boyle's Pneumatical Experiments* relating to *Sound*.
[g] This *Article* alſo remains but imperfectly proſecuted.

tho the ſtrait ones require a ſomewhat ſtronger Blaſt. The Figures of *Recorders*, and *Pipes*, are ſtrait; but the Recorder has a leſs Bore above; and a greater below. The Trumpet has the Figure of the Letter S [h], which makes the purling Sound, *&c.* Generally the ſtrait Line makes the cleareſt and roundeſt Sound; and the crooked the more hoarſe and jarring.

Trials of differently figured Bores recommended.

2. Trial ſhould be made with a ſinuous Pipe, having four Flexures: as alſo with a Pipe made in the form of a Croſs, and open in the middle; and again with an angular Pipe: to ſee what would be the Effects of their ſeveral Sounds. Try likewiſe a circular Pipe; made perfectly round, with a Hole to blow in; and another not far from that; but with a Tranſverſe, or Stop between them; ſo that the Breath may go the round of the Circle, and iſſue at the ſecond Hole [i].

Differently figured Solids.

3. Percuſſions may be likewiſe tried in ſolid Bodies of ſeveral Figures; as Globes, Flats, Cubes, Croſſes, Triangles, *&c.* and their Combinations; as Flat againſt Flat, Convex againſt Convex, Convex againſt Flat, *&c.* to ſhew the diverſities of the Sounds they produce. Try alſo the difference of Sounds in ſeveral Thickneſſes of hard Bodies, when ſtruck. I have tried, that a Bell of Gold yields an excellent Sound; not inferior to one of Silver or Braſs, but rather better [k]: yet a piece of Gold Coin, ſounds much flatter than a piece of Silver.

4. The Harp has its Concave running croſs-wiſe to the Strings; and no Inſtrument yields ſo melting and prolong'd a Sound as the *Iriſh-Harp* [l]. So that if a Virginal were made with a double Concave; the one all the Length, as the Virginal has; the other at the end of the Strings, as the *Harp* has; it might make the Sound more perfect, or not ſo ſhallow and jarring. It may be tried without any Sound-board along; but only Harp-wiſe at one end of the Strings: or laſtly, with a double Concave; one at each end of the Strings [m].

SECT. XVI.

Of the Mixture of Sounds.

1. THERE is an apparent diverſity between viſible and audible Species, in this; that the viſible do not mix in the Medium; but the audible do: for we can ſee a number of Trees, Hills, Men and Beaſts, at

[h] Some Trumpets have a *Circular Turn* in the middle.

[i] Is not this the Structure of the little round *Horn* or *Pipe* uſed by the *Poſtillions* in *Germany*; which gives a very odd Sound, not to be deſcribed by Words; being a kind of mixture of Shrillneſs, Loudneſs, and Stops, ſomewhat reſembling the Braying of an Aſs?

[k] Was the *Gold* pure, or alloy'd? One would not expect that ſo ſoft a Metal as pure Gold, ſhould ring clear and ſtrong.

[l] Obſerve, that the *Iriſh Harp* has metalline Strings; and is play'd with the Nails; not the Ends of the Fingers; as the *Welch Harp* is, the Strings whereof are Gut.

[m] What is the new Contrivance practiſed in *upright Harpſicords?* Theſe Experiments are of the ſame kind with thoſe recommended above, *Sect.* VIII. and regard the Improvement of *Muſical Inſtruments.*

at once; without the one confounding the other: but if ſo many Sounds came from ſeveral Parts, they would utterly confound each other. Thus Voices, or Concerts of Muſick make Harmony by Mixture [n], which Colours do not. 'Tis true, indeed, that a great Light drowns a ſmaller; as the Sun does that of a Glow-worm; and a great Sound drowns a leſs. So likewiſe, if there were two Glaſs Lanthorns, the one of a Crimſon Colour, the other of an Azure, and a Candle were included in each; I ſuppoſe theſe colour'd Lights would mix and caſt a Purple Colour upon white Paper [o]. And even Colours yield a faint and weak Mixture; for white Walls make Rooms more lightſome than black. But the Confuſion in Sounds, and the Diſtinctneſs of viſible Objects proceeds from hence, that the Viſion is made in right Lines, by means of ſeveral diſtinct Cones of Rays; whence there can be no Coincidence in the Eye, or viſual Point: whereas Sounds, that move in oblique and crooked Lines, muſt needs meet and diſturb one another [p].

What makes the trueſt Harmony.

2. The ſweeteſt and beſt Harmony is made, when every Part, or Inſtrument is not heard by itſelf, but a general Concent of them all; which requires the Audience to be at ſome diſtance: after the ſame manner as the mixture of Perfumes is received; or the Smells of ſeveral Flowers in the Air [q]. The Diſpoſition of the Air, as to other Qualities, unleſs joined with Sound, has no great effect upon Sounds: for whether the Air be light or dark, hot or cold, in ſilent Motion, or at Reſt, ſweet or fetid, &c. this can make only ſome petty Alteration: but Sounds diſturb and alter one another; ſometimes by drowning, ſometimes by jarring and diſcording, and ſometimes by confounding with each other; and ſometimes the one mixes and compounds with the other, and makes Harmony [r].

In what proportion to the Original, Sounds are propagated.

3. Two Voices of the ſame Loudneſs will not be heard twice as far as one of them alone; and two Candles of equal Light, will not render Things viſible, twice as far as one. The *Cauſe* lies deep; but it ſhould ſeem that the Impreſſions from the Objects of the Senſes mix reſpectively, every one with its kind; but not in proportion: the Reaſon may be, that the firſt Impreſſion, which is from Privative to Active, as from Silence to Noiſe,

[n] Is it not the Excellence of Concerts, and the Beauty, or Perfection of Harmony, to have the Sounds of different Inſtruments perfectly embodied as it were, or mixed together, like the different Colours of Light, ſo as to ſtrike the Ear with one compound Senſation, as if it came from a ſingle Inſtrument, like Light from the Sun? And if ſo; cou'd not ways be contrived, by ſome particular Structure of the Muſick-Room, or *Opera Houſe*, to incorporate theſe Sounds; before they came to the Ears of the Audience? And by a ſuitable Contrivance of this kind, might not a *Dutch* or an *Engliſh* Concert be render'd as agreeable as an *Italian* one? See the next Paragraph below.

[o] Sir *Iſaac Newton* has many Particulars relating to this Subject, both in his *Opticks* and *Principia*.

[p] See this Matter farther clear'd up by Sir *Iſaac Newton*. Princip. Lib. II. Prop. 50. *Schol.*

[q] This Compariſon ſeems very well to explain the Nature of Concert. See the *Note* upon § 1. above.

[r] Is this ſtrictly and fully explained by Sir *Iſaac Newton's* Doctrine of Sounds; which makes them no more than propagated Pulſes of the Air, proceeding from tremulous Bodies? See *Princip.* Lib. II. Prop. 50.

or from Darkneſs to Light, is a greater degree, than from leſs Noiſe to more Noiſe, or from leſs Light to more Light. The Reaſon of this again may be, that the Air after it has received a Charge, does not receive a greater Charge, with the ſame Appetite, as at firſt. But to determine, the increaſe of Virtues, in proportion to the increaſe of Matter, is a large Field, that requires a particular Treatment [r].

SECT. XVII.

Of the Melioration of Sounds.

Sounds meliorated by Smoothneſs in the ſounding Body.

1. ALL concurrent Reflexions make Sounds greater; but if the Body that gives the original Sound, or the Reflexion, be clean and ſmooth, it makes them ſweeter. Trial may be made in a Lute or Viol, with the Belly of poliſh'd Braſs, inſtead of Wood. We find even in the open Air, that the Wire String is ſweeter than the Gut-ſtring [s]. And for Reflexion, Water excels: as we find in Muſick near a River; and in Echoes. It has been tried, that a Pipe a little moiſtned on the inſide, yet ſo as to leave no Drops, makes a more ſolemn Sound, than if the Pipe were dry; yet with a ſweet degree of Purling: for all porous Things, by being moiſt, or, as it were, in a ſtate between dry and wet, become a little more even and ſmooth: but the Purling, which proceeds from Inequality, I take to be cauſed between the ſmoothneſs of the inward Surface of the Pipe, which is wet; and the reſt of the Wood of the Pipe, to which the wet does not reach [t].

By dry Weather, and long keeping of the Inſtrument.

2. Muſick within Doors, ſounds better in froſty Weather; perhaps not ſo much from the Diſpoſition of the Air, as of the Wood or String of the Inſtrument; which is thus made more criſp, and thence more porous or hollow: and we find that old Lutes ſound better than new ones, for the ſame Reaſon; ſo do Lute-ſtrings that have been long kept [v].

By the mixture of open Air with confined.

3. Sound is likewiſe meliorated by the mixing of open Air, with confined Air. Trial, therefore, may be made of a Lute, or Viol, with a double Belly; and another Belly with a Knot over the Strings; yet ſo as to leave ſcope enough for the Strings to play below that Belly. Trial may be likewiſe made

[r] This is a Subject that ſeems properly to fall under Mathematical Conſideration; after particular Experiments have been made. Something conſiderable is done in this way by *Galileo*, Sir *William Petty*, and others in a few Subjects: but the Deſign has by no means been extended to all ſorts of *Virtues*, *Powers*, and *Effects*, as it deſerves; particularly in *Odours*, *Electricks*, *Magneticks*, *Menſtruums*, &c.

[s] This is not judged ſo by all Ears; tho poſſibly a Gut-ſtring cannot be made ſo ſmooth and even as the Wire-ſtring.

[t] It may perhaps be a *contradictory Inſtance* to theſe, that the Sound of an *Ivory Hautboy* is not ſweeter than one of *Wood*. And both in this, and all other Enquiries, the *contradictory Inſtances* ſhould be ſought with as much Diligence as the concurrent; if we deſire to come at the *Forms of Things*.

[v] It might deſerve to be tried, whether *falſe* Strings becoming *true* by keeping, as they have been found to do, acquire an equal thickneſs, in their Parts, which they had not before.

made of an *Iriſh* Harp, with a Concave on both Sides: tho perhaps it might thus reſound too much; whereby one Note would overtake another. To Sing in the Hole of a Drum, makes the Voice ſweeter. So I conceive it would, if a Song in Parts, were ſung in at ſeveral Drums: and for Elegance ſake, there might a Curtain be drawn between the Drums and the Audience.

By Equality in the Body of the Inſtrument.

4. The Sound created in a Wind-Inſtrument, between the Breath and the Air, is meliorated, by communicating with a more equal Body of the Pipe: for there would doubtleſs be a different Sound in a Trumpet or Pipe of Wood; from that of a Trumpet or Pipe of Braſs. It were proper to try the Effects of Braſs Recorders, and Braſs Horns [w].

By the Intenſion of the Hearing, and a Suſpenſion of the other Senſes.

5. Sounds are meliorated by the intenſion of the Senſe, whilſt the other Senſes are collected to the particular Senſe of Hearing, and the Sight ſuſpended: whence Sounds are ſweeter in the Night, than in the Day; and I ſuppoſe ſweeter to blind Men than to others. And 'tis found, that between ſleeping and waking, when all the Senſes are bound, Muſick is far ſweeter, than when one is full awake [x].

SECT. XVIII.

Of the Imitation of Sounds.

Whence the Imitation of Sounds proceeds in living Creatures.

1. 'TIS ſtrange, when attentively conſider'd, how Children, and ſome Birds learn to imitate Speech. They take no Notice at all of the Motion of the Mouth; for Birds are as well taught in the Dark as by Light. The Sounds of Speech are very curious and exquiſite: whence one would think it were a Leſſon hard to learn. 'Tis true, it is conquer'd with Time, by Degrees, and with many Trials; but all this does not ſolve the Wonder. It would almoſt make one think there is ſome Tranſmiſſion of Spirits; and that the Spirits of the Teacher put in Motion, work with the Spirits of the Learner, a pre-diſpoſition to imitate; and ſo to perfect the Imitation by degrees [y]. And for Imitation, 'tis certain, there is in Men and other Creatures, a pre-diſpoſition to imitate. How readily do Apes and Monkies imitate all the Motions of Men? And in the catching of Dottrels, we ſee how the fooliſh Bird plays the Ape in Geſtures; and no Man, in Effect aſſociates with others, but he learns unawares ſome of their Geſture, Voice, or Manner.

[w] By what phyſical means is the Sound of a Violin made to reſemble that of a *Drum*, a *Hautboy*, the *French-Horn*, the *Bag-Pipe*, the *Organ*, &c. as in a skilful Hand it does to great Exactneſs.

[x] All the other ways of *meliorating Sounds* ſhould be here enumerated. Conſider the uſe of *Sound-Boards*; and their beſt Figure; a proper one to place behind the Actors upon the Stage, that may meliorate the Voices, and convey them better to the Pit and Galleries, *&c.*

[y] See the *Articles* IMITATION and SYMPATHY.

Birds imitate Sounds without being taught by Man.

2. In the Imitation of Sounds, 'tis not neceſſary that Man ſhould be the Teacher: for Birds will learn of one another; without any Reward, as by feeding, or the like, given them in way of Encouragement. Beſides, Parrots will not only imitate Voices, but Laughing, Knocking, the Squeaking of a Door, or a Cart-wheel; and any other Noiſe they hear [z].

Only Birds imitate human Speech.

3. No Brute can imitate the Speech of Man; but only Birds: for the Ape, that is otherwiſe ſo ready to imitate, attains not to any degree of Speech; tho there are Dogs, which if a Perſon howl in their Ear, will fall a howling, and continue it a great while. This aptneſs of Birds above Beaſts, in imitating the human Speech, ſhould be farther examined. Beaſts have thoſe Parts which are accounted the Organs of Speech, as Lips, Teeth, &c. more like to Men than Birds have: and for the Neck, many Beaſts have it as long as Birds. What better Gorge or Apparatus Birds have, may be farther enquir'd. The Birds that are known to ſpeak, are *Parrots*, *Pies*, *Jays*, *Daws*, and *Ravens* [a]: among which, *Parrots* have a hooked Bill, the reſt not.

Whence the ſuperior aptneſs of Birds for imitating Voices.

4. But perhaps this aptneſs of Birds lies not ſo much in the Conformity of the Organs of Speech, as in their Attention: for Speech muſt come by Hearing and Learning; and Birds attend and mark Sounds more than Beaſts; becauſe they are naturally more delightd with them, and practiſe them more; as appears from their Singing [b]. Thoſe who teach Birds to ſing, keep them awake, to increaſe their Attention. And Cock Birds among ſinging Birds are always the better Singers; perhaps, becauſe they are more lively, and liſten more.

5. Aſſiduity and Application in imitating Voices, conduces much to Imitation: whence there are certain Mimicks who will repreſent the Voices of Players and others to the Life. And there have been thoſe who could counterfeit the Diſtance of Voices, ſo as that when they ſtand cloſe by; you would think the Speech came afar off. How this is done may be farther examined: tho I ſee no great Uſe of it but for Impoſture [c].

SECT.

[z] The Stories related of Parrots, are ſome of them very extraordinary; but ſcarce any more remarkable than that inſiſted upon by Mr. *Locke*, in his *Eſſay upon Human Underſtanding*; where the Parrot ſeem'd not only to ſpeak diſtinctly, but to hold a Dialogue rationally; and appoſitely imitated the Cluck of a Hen, in uſing the human Voice.

[a] The foreign Speaking-Birds ſhould be alſo enumerated.

[b] It is an agreeable ſurprize to ſee with what Attention a *Canary Bird* will take a Leſſon from the Flagelet; and in Time be brought to ſing an intricate *Italian Air*; provided it be not too long. Tho the Bird is ſoon apt to forget it, unleſs his Memory be frequently refreſhed by the Maſter.

[c] Many Perſons have ſeen a remarkable Inſtance of this kind in a certain Smith of *London*, who had an extraordinary Talent in making his Voice appear to come from any part of the Room, or Houſe, where he was; ſo as to work ſurprizing Effects upon thoſe who were not let into the Secret: and thus, 'tis ſaid, he once counterfeited a Man's Voice coming out of a large Cask, in a Cart loaded with empty Casks, as it was going along the Street; to the great Aſtoniſhment and Perplexity of the *Carman*.

SECT. XIX.

Of the Reflexion of Sounds.

1. THere are three kinds of *Reflexion in Sounds*; viz. (1.) *Concurrent*; (2.) *Iterant*, or *Echo*; and, (2.) *Super-reflexion*, or the Echo of an Echo. The Reflexion of viſible Objects, by Mirrors, may be commanded; becauſe, paſſing in right Lines, they may be directed to any Point: but the Reflexion of Sounds is hard to direct; becauſe a Sound, filling larger Spaces in arched Lines [x], cannot be ſo guided: whence the Ways of making artificial Echoes have not been practiſed [y]. And no Echo, yet known, returns in a very narrow Space. *Three kinds of Reflexions in Sounds.*

2. The natural Echoes are made by Walls, Woods, Rocks, Hills, and Banks. As for Water being near, it makes a concurrent, but farther off, an iterant Echo: for there is no difference between the concurrent Echo and the iterant, beſides the quickneſs, or ſlowneſs of the Return. But Water, doubtleſs, helps the propagation of the Echo; as well as of original Sounds. *The Doctrine of Echoes; viz. By what things they are made.*

3. If a Perſon ſpeak in a Trunk ſtopt at the farther end, the Blaſt returns upon the Mouth; but no Sound at all: for the cloſeneſs which preſerves the Original, is not able to preſerve the reflected Sound. Beſides, Echoes are ſeldom created but by loud Sounds: whence there is leſs Hope of making artificial Echoes in Air, confined within a narrow Concave. Yet it has been tried, that by leaning over a Well twenty-five Fathom deep, and ſpeaking, tho but ſoftly, the Water returned an audible Echo. It ſhould alſo be tried, whether ſpeaking in Caves, where there is no Iſſue, except at the Mouth, will not yield an Echo, as Wells do.

4. Echoes move as original Sounds do, in a Sphere of Air. It were proper to try the Production of Echoes, where the reflecting Body makes an Angle; as againſt the Return of a Wall, *&c.* In Mirrors, there is the like Angle of Incidence, from the Object to the Glaſs, as from the Glaſs to the Eye [z]. And if a running Ball be ſtruck ſide-way, the Rebound will be as much the contrary way: and whether there be any ſuch Reflexion in Echoes, may be tried; that is, whether a Perſon will hear better, by ſtanding on the ſide of the reflecting Body, than by ſtanding where the Voice is; or any where, in a Right-line, between. Trial, likewiſe, ſhould be made, by *Their Motion.*

[x] As being propagated Pulſes of the *Atmoſphere*, or *Medium*.

[y] Might not the making of artificial *Echoes* be now practiſed with Succeſs? Surely, the many Diſcoveries every where allowed to be made in the *Buſineſs of Sounds*, ſince the Invention of the *Air-pump*, and the Improvements of Sir *Iſaac Newton*, may enable us to produce more Effects than before: otherwiſe it is a Preſumption, that theſe Diſcoveries are either not juſt, or not very ſignificant; or elſe, that the modern Philoſophers are very indolent.

[z] It is an AXIOM, in *Opticks*, that the *Angle of Incidence* is equal to the *Angle of Reflexion*, on all kinds of Surfaces.

by ſtanding nearer the place of Reflexion, than the Speaker; and again, by ſtanding farther off; to find whether Echoes, as well as original Sounds, be not ſtrongeſt near hand [a].

The Super-reflection of Echoes.

5. In many Places may be heard a number of Echoes one after another: that is, when there is a variety of Hills, or Woods, ſome nearer, ſome farther off: ſo that the Return from the farther being laſt created, will be likewiſe laſt heard. As the Voice goes round the Perſon who ſpeaks, ſo does the Echo; for there are many Back-echoes, as well as Front ones.

To make an Echo repeat ſeveral Words diſtinctly.

6. To make an Echo report three, four, or five Words diſtinctly, 'tis requiſite that the reflecting Body be at a good diſtance: for if it be near, yet not ſo near as to make a *concurrent Echo*, it chops with you of a ſudden. 'Tis neceſſary, likewiſe, that the Air be not much confined; for Air confined at a great diſtance, has the ſame Effect as Air at large, in a ſmall diſtance. And therefore, in the Trial of ſpeaking in the Well, tho the Well was deep, the Voice came back ſuddenly; and would bear the Report but of two Words.

The Echo at Pont-Charenton.

7. With regard to Echoes upon Echoes, there is a curious Inſtance thereof, about three or four Miles from *Paris*, near a Town called *Pont-Charenton*; upon the River *Sein*. The Room is a Chapel, with the Walls all ſtanding, both at the Sides and at the Ends; and two Rows of Pillars, after the manner of Iſles: the Roof is open, and no Arch-work remaining near any of the Walls. There was, againſt every Pillar, a Stack of Billets, piled above a Man's height; which the Watermen, that bring Wood down the *Sein* in Sacks, laid there for their Convenience. Speaking at the one End, it returned the Voice thirteen ſeveral times; and, I was told, that it would return it ſixteen times: for I was there about three of the Clock in the Afternoon; and it is beſt, as all Echoes are, in the Evening. 'Tis manifeſt, this is not different Echoes from ſeveral Places; but a toſſing of the Voice, as a Ball, different ways: like Reflections in Looking-glaſſes; where, if you place one Glaſs before, and another behind, you ſhall ſee the Glaſs behind, and the Image within the Glaſs before; and again, the Glaſs before, in that; and many ſuch Super-reflexions, till the Images of the Object fail, and die at laſt: being in every Return weaker and more ſhadowy. So the Voice in that Chapel, makes ſucceeding Super-reflexions; melting by degrees; and every Reflexion growing weaker than the former. Thus, if you ſpeak three Words, it will, for three times, perhaps, report the whole three Words; then the two latter Words, for a few times; and then the laſt Word alone, a few times; ſtill fading, and growing weaker. And whereas, in Echoes of one Return, it is extraordinary, to hear four or five Words; in this Echo of ſo many Returns, you hear above twenty Words for three. The like Echo upon Echo, but only with two Reports, has been obſerved by ſtanding between a Houſe and a Hill, and hollowing towards the Hill; for the Houſe will give a Back-echo; which may be miſtaken for the other, tho the latter be the weaker.

8. There

[a] The making of theſe Trials would, doubtleſs, diſcover ſome conſiderable Secrets for the Improvement of *Phonicks*.

8. There are certain Letters which an Echo can hardly expreſs; as *S*, for inſtance; eſpecially when a principal Letter in a Word. Thus, when I went to hear the Echo at *Pont-Charenton*, there was an old *Pariſian*, who took it to be the Work of good Spirits; for, ſaid he, call out *Satan*, and the Echo will not deliver back the Devil's Name; but cries, *Va tén*, which, in *French*, is, *begone:* and thereby I found that an Echo would not return *S*; as being but a hiſſing, and interior Sound. *There are certain Letters inexpreſſible by Echoes.*

9. Some Echoes are ſudden, and chop again, as ſoon as the Voice is delivered; others are more deliberate, or take more time between the Voice and the Echo; which is cauſed by the Nearneſs, or Diſtance: ſome will report a longer train of Words, and ſome a ſhorter; ſome as loud as the Original, or, ſometimes, louder; and others weaker and fainter. Where Echoes come from ſeveral Parts at the ſame diſtance, they muſt make, as it were, a Choir of Echoes; and ſo increaſe the Report, and give a continued Echo; as we find in ſome Hills that ſtand in compaſs like a Theatre [b]. *The Difference of Echoes.*

10. It does not yet appear, that there is any *Refraction* in Sounds, as in Viſion: for, I do not think, if a Sound ſhould paſs through different Mediums; as Air, Cloth, Wood, *&c.* it would deliver the Sound in a different Place from that where it tends: which is the proper effect of Refraction [c]. *Whether there be a Refraction in Sounds?*

SECT. XX.

Of the Relation and Difference between Light and Sound.

1. BOth viſible and audible Species diffuſe themſelves in a Sphere; and fill the whole thereof, to certain Limits; being carried to great Lengths; but languiſh, and leſſen by degrees, according to the diſtance of the Objects from the Senſories. (2.) The whole Species of both, are in every ſmall portion of the Air, or Medium; ſo that they paſs through ſmall Chinks, without confuſion; as appears from Levels, to the Eye, and from Slits, to the Ears. (3.) Both of them are ſuddenly and eaſily generated and *The Particulars wherein Sound and Sight agree.*

[b] Is not here a Foundation for ſome conſiderable Improvement in the Buſineſs of Sounds; eſpecially with relation to *Muſick*, and *Concerts?*

[c] Are not all the common Sounds, in a certain Senſe, refracted? for they all move thro' a very unequal and mixed Medium, the Atmoſphere, compounded of Water, Air, Salts, and Millions of other Matters; ſo that it ſhould ſeem we have never yet heard any, pure, direct, or unrefracted Sound; which, perhaps, requires, a pure elaſtical Medium, ſuch as pure and perfect Air. And if ſuch a Medium of Sounds could be procured, what would be the Effect of our common Inſtruments play'd in it? What the Effect of ſuch a pure *Medium* condenſed to a certain degree? *&c.* Sir *Iſaac Newton*'s Doctrine of Sounds might, probably, be of ſome ſervice in this Enquiry, were it but more underſtood, or adapted to the Capacities of Artificers; who, at preſent, are rather confounded than inſtructed by it. The Biſhop of *Ferns* and *Leighlen*, has ſome uſeful, and plainer Intimations, relating to this Subject of *refracted Sounds*; or, as he terms it, Cataphonicks, or Catacouſticks. See *Philoſophical Tranſactions*, Numb. 156.

and propagated; and likewiſe periſh ſwiftly and ſuddenly; as upon removal of the Light, or touching the ſounding Body. (4.) Both of them receive and carry exquiſite and accurate Differences; as of Colours, Figures, Motions, Diſtances, in Viſibles; and of articulate Voices, Tones, Songs, Quavers, *&c.* in Audibles. (5.) Both of them in their Virtue and Operation appear to emit no corporeal Subſtance into their Mediums, or the Sphere of their Activity; nor to cauſe any evident local Motion in their Mediums, as they paſs: but only to carry *certain ſpiritual Forms*; the perfect Knowledge of the *Cauſe* whereof is hitherto ſcarcely attained [d]. (6.) Both of them ſeem not to generate or produce, any other Effect in Nature, but ſuch as appertains to their proper Objects and Senſes; and are otherwiſe barren. But both of them, in their own proper Action, have three manifeſt Effects: the *firſt* is, that the ſtronger Species drown the leſſer; as the Sun drowns the Light of the Stars; and the Report of Ordnance, the Voice. The *ſecond*, that an Object of Surcharge, or Exceſs, deſtroys the Senſe; as the Light of the Sun, the Eye; and a violent Sound, the Hearing. The *third* is, that both of them may be reverberated; as in Mirrors, and Echoes. (7.) Neither of them deſtroys, or hinders the Species of the other, tho they meet in the ſame Medium; as Light, or Colour, does not hinder Sound; and *vice verſa*. (8.) Both of them affect the Senſe in living Creatures; and yield Objects of pleaſure and diſlike: tho theſe Objects alſo affect, and operate upon inanimate Things; *viz.* ſuch as have ſome conformity with the Organs of the two Senſes: thus the viſible Species operate upon a Lens, which is like the Pupil of the Eye; and the Audible upon Places of Echo, which, in ſome ſort, reſemble the Cavern and Structure of the Ear [e]. (9.) Both of them operate variouſly, according to the Diſpoſition of the Medium: thus, a trembling Medium, as Smoke, makes the Object appear to tremble; and a riſing or falling Medium, as the Air diſturbed by Winds, makes the Sounds therein to riſe or fall. (10.) The Medium moſt favourable to both, is *Air*; whereto Glaſs, Water, *&c.* are not comparable. (11.) In both of them, where the Object is fine and accurate, it greatly conduces to have the Senſe intent and erect: thus we contract the Eye when we would ſee ſharply; and erect the Ear when we would hear attentively; which, in Beaſts, that have moveable Ears, is more manifeſt [f]. (12.) The Rays of Light, when multiplied and condenſed, generate Heat; which is a different Action from the Action of Sight: and the Multiplication and Condenſation of Sounds generates an extreme Rarefaction

[d] If this *Cauſe* be meant of the manner wherein the Senſations in Viſion and Hearing are performed, it ſtill remains unknown: tho the *phyſical* or *remote Cauſes* of both are thought, at this time, to be very well underſtood. And theſe *Cauſes* are ſufficient for the Production of *great Effects*: ſo that it might ſoon be ſhewn, by endeavouring to produce *ſuch Effects*, whether we are acquainted with theſe *Cauſes*, or not.

[e] This will not appear ſtrange, if it be remembered that *Action* and *Re-action* are equal.

[f] Do not Animals, when they would hear diſtinctly, turn their Ear, in a particular manner, to the Place from whence they ſuſpect the Sound proceeds? and what preciſe *Angle of Inclination* is this?

Rarefaction of the Air; which is a material Action, differing from the Action of Sound; if it be true that Birds, in their Flight, have been made to fall down by great Shouts [g].

The Particulars wherein they differ.

2. (1.) Viſible Species ſeem to be Emiſſions of the Rays of Light from the viſible Object, almoſt in the manner of Odours [h], only that they are more incorporeal; but *audible Species* ſeem to participate more of local Motion, like Percuſſions or Impreſſions made upon the Air [i]. So that, as all Bodies appear to operate two Ways, *viz.* either by the Communication of their Natures, or by the Impreſſions and Signatures of their Motions; the Diffuſion of *viſible Species* ſeems to partake more of the former, and *audible Species* of the latter. (2.) The *Species of Audibles* ſeem to be more manifeſtly carried through the Air than the Species of Viſibles: as a contrary ſtrong Wind, will not much hinder the Sight, tho it does the Hearing. (3.) One Difference betwixt viſible and audible Species, is, above all others, very remarkable; as that whereon many ſmaller Differences depend; *viz. Viſibles* are carried in Right-lines, and *Audibles* in Curves. Whence it is, that Viſibles do not intermix and confound one another, as Sounds do. And hence the Solidity of Bodies does not much hinder the Sight, provided the Bodies be clear, and the Pores in a Right-line; as in Glaſs, Cryſtal, Diamonds, Water, *&c.* but a thin Scarf or Handkerchief, tho Bodies nothing ſo near ſolid, hinder Viſion; whilſt ſuch porous Bodies do not much hinder the Hearing; which ſolid Bodies almoſt ſtop, or, at the leaſt, weaken. Hence alſo, ſmall Glaſſes ſuffice for the Reflexion of Viſibles; but greater Spaces are required to the Reverberation of Audibles. (4.) Viſible Objects are ſeen farther than Sounds are heard; that is, in proportion to their Magnitude: for, otherwiſe, a great Sound is heard farther than a ſmall Body can be ſeen. (5.) Viſibles generally require ſome diſtance between the Object and the Eye; but in Audibles, the nearer the Sound is to the Senſory, the ſtronger it proves. But in this, there may be a double Error; the one, becauſe Viſion depends upon Light; and any thing that touches the Pupil of the Eye all over, excludes the Light. For I had it from a very credible Perſon, who was himſelf cured of a *Cataract*; that while the Silver Needle removed the Film of the *Cataract*, he never ſaw any thing more clear, or perfect, than that white Needle: no doubt, becauſe the Needle was leſs than the Pupil of the Eye, and ſo eclipſed not the Light from it [k].

[g] This laſt Particular requires a further Examination; for there ſeem to be, hitherto, no certain Inſtances produced, to ſhew, that mere Sound, without *Heat*, *Flame*, or *Exploſion*, does cauſe a Rarefaction of the Air. See *Sect.* II. 3. and conſult Sir *Iſaac Newton*'s Doctrine of Sounds, *Princip.* Lib. II.

[h] The Compariſon holds true in *lucid*, but not in *illumined* Bodies; lucid Bodies being ſeen by means of their own Light, but *illuminated Bodies* by a borrowed one: whereas Odours ſeem to proceed only from the odoriferous Bodies themſelves; unleſs there be any ſcentleſs Bodies that reflect borrowed *Odours*.

[i] Are not theſe the ſame that Sir *Iſaac Newton* calls *Pulſes*.

[k] Does Sir *Iſaac Newton*'s Theory of Viſion, by Preſſure, reach this Caſe? or, is the Fact well confirmed? or is there not ſtill ſome Deficiency in our Knowledge of the *Cauſes* of Viſion; eſpecially in particular *Diſorders of the Eyes*? which ſeem very little underſtood; as may appear from the empirical Practices of *Oculiſts*.

The other Error may be, becauſe the Object of Sight ſtrikes upon the Pupil of the Eye directly, without any Interception; whereas the Cavity of the Ear keeps off the Sound a little from the Organ: ſo that there is ſome Diſtance required in both. (5.) *Viſibles* are ſooner carried to the Senſe than *Audibles*; as appears in Thunder and Lightning; the Flaſh and Report of a Gun, *&c.* I conceive alſo, that the *Species of Audibles* hang longer in the Air than thoſe of *Viſibles*: for altho, even Viſible Species hang ſome time, as when Rings are twirled round, they ſhew like Spheres; and a Fire-brand, carried ſwiftly along, leaves a Train of Light behind it, *&c.* yet Sounds ſeem to remain much longer; becauſe they are carried up and down with the Winds: and becauſe the diſtance of the Time is great, betwixt the Flaſh of a Cannon ſeen, and its Report heard, twenty Miles off[l]. (6.) There are no Objects found ſo odious and ungrateful to the Senſe in *Viſibles*, as in *Audibles*: for odious Sights rather diſpleaſe, as they excite the Memory of odious things, than by the immediate Object itſelf. Whence ſuch Sights, in Pictures, are not very diſagreeable; but in *Audibles*, the filing of a Saw is ſo offenſive as to ſet the Teeth on edge: and the Ear is preſently ſhocked at harſh Diſcords in Muſick. (7.) In *Viſibles*, if you come ſuddenly out of great Light into the Dark, or out of the Dark into a glaring Light; the Eye is dazled for a time, and the Sight confuſed: but whether there is any ſuch Effect after great Sounds, or after a deep Silence, ſhould be enquired. 'Tis an old Tradition, that thoſe who dwell near the Cataracts of the *Nile*, are deaf: but we find no ſuch Effect in Engineers, Millers, and thoſe that live upon Bridges. (7.) It ſeems that the Impreſſion of Colour is ſo weak, as not to operate but by a Cone of direct Rays, or Right-lines; whereof the Baſis is in the Object, and the vertical Point in the Eye; whence there is a Corradiation, and Conjunction of Beams: and theſe Beams, ſo ſent forth, are not ſufficient to produce the like borrowed, or ſecondary Beams, without Reflexion: for the Beams paſs, and give little tincture to the Air adjacent; otherwiſe we ſhould ſee Colours out of a Right-line. But tho this happens in Colours, it is not ſo in the Body of Light: for when there is a Skreen between the Candle and the Eye, yet the Light paſſes the Paper, for example, when a Perſon is writing by Candle-light; ſo that the Light is ſeen where the Body of the Flame is not ſeen; and where any Colour would not be ſeen, that was placed where the Body of the Flame is. I judge, that Sound is of this latter Nature; for when two Perſons converſe, with a Wall betwixt them, the Voice heard is not, perhaps, only the original Sound which paſſes in an Arch-line: but the Sound that paſſes above the Wall, in a Right-line, may produce the like Motion round about it, as the firſt did; tho weaker[m].

SECT.

[l] See above, *Sect.* XII. 2, and 4.

[m] This Compariſon betwixt *Sight* and *Hearing*, might be carried to a much greater Length: as it ſtands here, 'tis little more than a Recapitulation of what is before delivered; only with a View to ſuch a Compariſon. They are compared, in ſome few Reſpects, by Sir *Iſaac Newton* in his *Opticks* and *Principia*; and, in ſome others, by the learned *Prelate* ſo often mentioned already. But the Subject is by no means exhauſted; or brought to afford the neceſſary AXIOMS FOR PRACTICE.

2

SECT. XXI.

Of the Sympathy, or Antipathy, of Sounds with one another.

1. ALL *Concords* and *Diſcords* of Muſick, may be aptly called the *Sympathies* and *Antipathies* of *Sounds*: ſo, in that Muſick termed Broken, or Conſort-muſick; ſome Conſorts of Inſtruments, are ſweeter than others: a thing not hitherto ſufficiently obſerved. Thus, the *Iriſh-harp* and the *Baſe-viol*, conſort well; ſo do the Recorder and Stringed-inſtruments; Organs and the Voice, *&c.* but Virginals and the Lute; the *Welſh-harp* and *Iriſh-harp*; or the Voice and Pipes, alone; agree not ſo well. But for the MELIORATION OF MUSICK, with regard to exquiſite Conſorts, there is much Matter left for Trial and Enquiry [n]. *What Inſtruments ſuit beſt in Conſort.*

2. 'Tis a common Obſervation, that if a *Lute*, or *Viol*, be laid upon its Back, with a ſmall Straw upon one of the Strings; and another Lute, or Viol, be laid by it; and the Uniſon to the former String be ſtruck in the latter; it will make that String move; as appears, both directly to the Eye, and by the Effect of making the Straw fall off. And the like happens if the *Diapaſon*, or Eighth to that String, be ſtruck; either in the ſame Lute, or Viol, or in others lying by: but in none of theſe, is there any Report of Sound to be diſcovered, but only Motion. It has been adviſed, that a Viol ſhould have a Set of Wire-ſtrings below, as cloſe to the Belly as a Lute, and then the Gut-ſtrings mounted upon a Bridge, as in ordinary Viols; ſo that, by this Means, the upper Strings being ſtruck, ſhould make the lower reſound by *Sympathy*, and thus meliorate the Muſick. If this ſucceed, *Sympathy* will appear to operate as well by the Report of Sound as by Motion. But this Device I conceive of no Uſe: becauſe the upper Strings, which are ſtopped in great variety, cannot maintain a *Diapaſon* with the lower, which are never ſtopped; but if it has any Advantage, it muſt be ſeen in Inſtruments that have no Stops; as Virginals and Harps: wherein trial may be made of two Rows of Strings, diſtant the one from the other. *An Experiment of Sympathy, recommended for the Melioration of Muſick.*

3. The Experiments of Sympathy may, perhaps, be transferred from ſtringed Inſtruments, to others; as, if there were two Bells in Uniſon in one Steeple, to try whether ſtriking the one would move the other, more than if it were a different Cord: and ſo in Pipes, of equal Bore and Sound, to try whether a light Straw, or Feather, would move in the one Pipe, when the other is blown in Uniſon with it. *The Experiment transferred.*

4. It ſeems both to the Ear and Eye, that the Inſtrument of Senſe has a Similitude, or Sympathy with that which gives the Reflexion: thus the Pupil *That the Organs of Senſe have an Affinity with thoſe things that affect them.*

[n] And, perhaps, the *Italians* themſelves, have not advanced Muſick to half that degree of Perfection it is capable of receiving from philoſophical Improvements, to be made by ſuch as have a *Head* as well as a *Hand*.

Pupil of the Eye is like Cryſtal, Glaſs, or Water; and the Ear, a ſinous Cavity, with a hard Bone, to ſtop and reverberate the Sound; like the Places of Echo °.

SECT. XXII.

Of the Means of Hindering, or Improving the Hearing.

Inſtances wherein the Hearing is obſtructed and promoted.

1. WHen a Man yawns, he cannot hear ſo well: the Membrane of the Ear being then extended; ſo as rather to repel the Sound, than attract it. We hear better when we hold our Breath, than otherwiſe; whence, in all Liſtening, Men hold their Breath: for, in all Expiration, the Motion is outwards; and therefore rather drives away the Voice, than draws it in. Beſides, in all Labour, that requires Strength, we hold the Breath; and liſtening after any Sound that is heard with difficulty, ſeems a kind of Labour.

An Inſtrument for Deafneſs.

2. Let it be tried, for a help to Hearing, to make an Inſtrument like a Funnel, the length of ſix Inches or more; the narrow part whereof may fit the Hole of the Ear, and the broader end ſwell much larger, like a Bell P. Let the narrow end of it be applied cloſe to the Ear; and obſerve, whether a Sound will not be heard diſtinctly at a greater diſtance than without this Inſtrument. I have been told, that in *Spain* they uſe an Inſtrument, which applied to the Ear, helps thoſe that are thick of hearing.

That Sound paſſes thro' the Noſtrils, if the Mouth be ſhut.

3. Tho the Lips be ſhut cloſe, there is a Murmur yielded by the Roof of the Mouth; as in dumb Men: but if the Noſtrils are likewiſe ſtopped, no ſuch Murmur can be made, unleſs in the Bottom of the Palate towards the Throat. Whence it appears, that a Sound in the Mouth, except ſuch as that juſt mentioned, paſſes from the Palate through the Noſtrils, if the Mouth be ſtopped.

SECT. XXIII.

Of the ſpiritual and fine Nature of Sounds.

That Echoes argue the ſpiritual Nature of Sounds.

1. THE Repercuſſion of Sounds, which we call Echo, is a great Argument of their ſpiritual Nature; for if it were corporeal, the Repercuſſion ſhould be cauſed in the ſame manner, and by the like Inſtruments, as the original Sound: but we ſee what a number of exquiſite Inſtruments

° Hence may be derived a capital Rule, not only for the making of new muſical Inſtruments, but alſo many other Engines and Inſtruments for helping, improving, and perfecting the Senſes. The Imitation of Nature is the ſhorteſt and ſureſt Method for Practice; but then Nature ought firſt to be well underſtood.

P. This is the Inſtrument now in common Uſe for the Deaf; and might, doubtleſs, be conſiderably improved; from a tolerable knowledge in *Phonicks*.

ments must concur in speaking: whereas there is no such things concerned in the returning of Words; but only a plain Stop and Repercussion [q].

2. The requisite Differences of articulate Sounds carried along in the Air, shew that they cannot be Signatures, or Impressions in the Air: for tho Seals make excellent Impressions; and tho Sounds in their first Generation, may be conceived as impressed; yet the Propagation and Continuance of them, without any new sealing, shews them not to be impressed [r]. *Sounds not Impressions*

3. All Sounds are suddenly made, and suddenly perish; but neither this, nor the exquisite Differences of them, is so wonderful: because the Quaverings and Warblings in Lutes and Pipes, are as quick; and the Tongue, tho but a gross Instrument, makes no fewer Motions in Speech than there are Letters in all the Words it utters. But that Sounds should be so speedily generated, and carried so far every way, in so short a time, is more surprizing. For example; if a Man speak aloud in the middle of a Field, he may be heard a Furlong round him; and that in articulate Sounds, entire, in every little Portion of the Air: and all this shall be done in less than a Minute. *Extraordinary Properties of Sound.*

4. The sudden Generation and Destruction of Sounds, must proceed from hence; either that the Air suffers some force by Sound, and then restores itself, as Water does; or, that the Air readily imbibes the Sound as grateful; but cannot maintain it: for the Air seems to have a secret Appetite of receiving Sound at first; but then other gross and more material Qualities presently suffocate it; like Flame, which is suddenly generated, but instantly extinguished, by the Enmity of the Air, or other ambient Bodies [s]. *The sudden Generation and Destruction of Sounds, whence.*

5. Sounds, in general, are divided into, (1.) Musical, and Immusical. (2.) Trebler, and Bass. (3.) Flat, and Sharp. (4.) Soft, and Loud. (5.) External, and Internal. (6.) Clear, Harsh, and Purling. And, (7.) Articulate, and Inarticulate [t]. *The Division of Sounds.*

6. We have taken some Pains in this *Enquiry* about Sound; not only because it is a secret and incorporeal Quality in Nature; but because we were willing, in our first Attempt towards a just *Natural and Experimental History*, to give *Conclusion.*

[q] This is easily cleared up on the Supposition of aerial *Pulses*.

[r] This drives at a higher, more immediate, and spiritual Explanation of Sounds, than that of the Impulse of the Air, with which we seem to rest generally satisfied.

[s] Let Sir *Isaac Newton* be consulted upon this Head. See *Princip.* Lib. II. Prop. 50.

[t] This Enquiry is not so far finished as those of *Winds*; *Life and Death*, &c. whence we find here no *Canons*, or *Axioms* deduced in form; tho there are the Seeds of several, sown through the whole. And whoever is disposed to improve the *History of Phonicks*, which is still greatly deficient, might do well to work upon this Plan; range the whole more exactly; add the later Instances; and draw out the *Axioms* according to the Directions of the *Novum Organum*, and the other more *finished Examples* of the Author, in the *History of Life and Death*, &c. Were a Man, with a tolerable Talent at Experiments, to proceed upon this Design, he might, doubtless, improve the Subject of *Acousticks* to a considerable Pitch; especially if he became acquainted with the Particulars intimated on this Head by the Bishop of *Ferns* and *Leighlin*; Dr. *Grandi*; and the Experiments of Mr. *Derham*; all of them to be found in the *Philosophical Transactions*. To which may be added, for the physical Part, Mr. *Boyle*; and, for the mathematical, Sir *Isaac Newton*. There are also some useful Hints to this Purpose, in the Essay of Mr. *Whiston* and Mr. *Ditton*, for discovering the *Longitude at Sea*.

give an Example of a tolerably exact *Enquiry*; intending to do the like in another *Article*, or two [v]: being desirous that Men should thoroughly perceive, what a severe and rigid thing every true Enquiry into Nature must necessarily be; and hence, accustom themselves to enlarge their Minds by the *Light of Particulars*, to the ample Measure of the Universe; and not contract the *Universe* to the narrow Measure of their own Minds [u].

SPIRITS IN BODIES.

Two kinds of Parts, in Bodies.

ALL solid Bodies consist of two different Parts; *viz. Pneumatical* and *Tangible*. The *pneumatical Substance* in some Bodies, is their native Spirit; in others, plain *Air* enters; as in Bodies dried by Heat, or Age: for when the *Native Spirit* goes out, and the Moisture with it, the Air, in time, gets into the Pores. And these Bodies are always more brittle; because the native Spirit is more yielding and flexible than Air. The *native Spirits*, also, admit of great Diversity; as being either hot, cold, active, dull, &c. whence most of the Virtues and Qualities of Bodies proceed; but the Air, intermixed, is without any particular Virtues; and makes things more insipid, and unactive [w]. See the *Articles* IMAGINATION, NATURE, and SYMPATHY.

SPONGES.

The Growth and Nature of Sponges.

Near the Bottom of the *Streights* are gathered great Quantities of *Sponges*, from the sides of Rocks; being, as it were, a large kind of tough Moss. This is the more remarkable, because there are few vegetable Substances that grow deep in the Sea; but these are sometimes gathered at the Depth of fifteen Fathom: and, when thrown on Shore, they seem of great Bulk; but when squeezed together, may be carried in a very small compass [x].

SPRINGS.

A Way of making artificial Springs.

It was reported by a sober Man, that an *artificial Spring* might be thus made. "Find out a Shelving-ground, where there is a great quick Fall "of Rain-water; and here bury a Stone Trough of a considerable length, "three

[v] As that of *Imagination, Vegetables, Sympathy*, &c.

[u] If farther Directions be wanted for the Conduct of Enquires, the Reader may find them in the *second Part* of the NOVUM ORGANUM.

[w] The due Prosecution of this Enquiry has been already more than once recommended; and is, possibly, of as great Consequence as any Enquiry in all Physicks: for if we *trace Nature closely in her Operations*, perhaps we shall find, that she uses the Mediation of these *Spirits* in all her latent Processes of Vegetation, Animalization, Mineralization, and the Production of numerous Changes in Bodies. But we would, by no means, anticipate the *Enquiry*; only endeavour to revive it: for it seems to have languished of late. See Dr. *Power*'s *Digression upon* Animal Spirits; in his *Experimental Philosophy*, pag. 61. See also, Sir *Isaac Newton*'s Doctrine of *Comets, Princip.* Lib. III. pag. 473, *etc.* and the Queries at the End of his *Opticks*.

[x] The large Quantity of Surface in Sponge, with regard to its Bulk, and the great Quantity of Water it will readily attract and retain, fit it for some considerable Purposes in *Physicks*. Thus, in particular, it has been successfully applied for the making of Hygrometers. See Mr. *Boyle*'s *Statical Hygroscope*.

" three or four Foot deep; with one End upon the high, and the other " upon the low Ground. Cover the Trough with Brakes to a good thick- " neſs; and throw Sand upon the top of the Brakes: and now, *ſays he*, " after ſome Showers are fallen, the lower end of the Trough will run like " a Spring of Water." This would be no Wonder, while the Rain laſted; but, he added, that it would continue long after the Rain was over: as if the Water multiplied itſelf upon the Air, by the help of the Coldneſs and Condenſation of the Earth, and the Aſſociation of the firſt Water [y]. See the *Article* TRANSMUTATION.

STAMMERING.

The *Cauſe of Stammering* is, perhaps, the *Refrigeration of the Tongue*; whence it becomes leſs apt to move: for Naturals generally ſtammer. But if ſtammering Perſons drink Wine moderately, they ſtammer leſs; becauſe Wine heats: and ſo 'tis common to ſtammer more in the firſt offer to ſpeak, than in continuance; becauſe the Tongue is warmed by the Motion. In ſome alſo, this Defect may proceed from the *dryneſs of the Tongue*; which likewiſe makes it leſs apt to move: for many ſtammering Perſons are cholerick; Bile inducing a dryneſs in the Tongue [z]. *The Cauſe of Stammering.*

SUGAR.

Sugar has aboliſhed the uſe of *Honey*: ſo that we have loſt the ancient Preparations of Honey, when it was more eſteemed [a]. It ſeems there was formerly Tree-honey [b]: and one of the Ancients relates, that in *Trebiſond*, there was *Honey* iſſuing from the Box-tree, which made Men mad. Again, in ancient time, there was a kind of Honey which, either of its own Nature, or by Art, would grow as hard as Sugar; and proved not ſo luſcious as ours [c]. They *The ancient Preparations of Honey to be ſupplied by thoſe of Sugar.*

[y] There may be reaſon to queſtion the Succeſs of this *Experiment*; but many improbable Experiments have ſucceeded, and many probable ones have failed: ſo fallible a thing is Reaſoning *à priori*. If it could be brought to bear, it might prove of conſiderable Uſe on many Occaſions; and afford an Intimation of the natural Origin of Springs.

[z] The *Cauſes* here aſſigned are, perhaps, rather accidental, or concomitant, than efficient; for Stammering may ſometimes proceed from a particular Conformation of the Organs of the Voice; and as well from a natural as acquired Ineptitude in them to the pronouncing of certain Letters. The Defect ſeems plainly catching by Imitation, as many have experienced; and may be remedied alſo, by a contrary Practice: and, doubtleſs, the *Art of curing Stammering* might be improved by proper Application. It ſeems a principal Rule, that the Stammerer accuſtom, or, as it were, break himſelf to a Habit of pronouncing ſlowly, and diſtinctly; more frequently dwelling upon thoſe Letters, or combinations of Letters, at which he is apt to ſtammer moſt.

[a] The Ancients had their *Confections*, *Honeys*, *Honey-balſams*, and other Preparations with Honey; after the ſame manner as we have our *Preſerves*, *Syrups*, *Elæoſaccharums*, &c. with Sugar.

[b] *Honey* appears to be a vegetable Juice, that is barely collected by the Bee.

[c] May not all Honey be converted to Sugar, by an eaſy *Encheireſis*? Do not *Honey*, *Raiſins*, &c. candy with Age, ſo as to yield *Grains* of actual Sugar? May not all the ſweet Subſtance contained in Malt, be converted into *Sugar*, and *Treacle*? Perhaps *Sugar* is not peculiar to the *Sugar Cane*; but may be obtained from all the ſweet Juices of Trees, Fruits, and Grain.

They had alſo a *Wine of Honey*; which they made by diſſolving the Honey in a large Quantity of Water, and ſtraining the Liquor: they afterwards boiled it to a Half, then poured it into earthen Veſſels, and ſoon after put it into Veſſels of Wood; and kept it for many Years. They have alſo, at this Day, in *Ruſſia*, and the Northern Countries, *Mead-ſimple*; which, well made, is a wholeſome Drink, and very clear. They make, likewiſe, in *Wales*, a *compound Mead*, with Herbs and Spices. To compenſate what we have loſt in Honey, 'tis pity but a SUGAR-MEAD WERE BROUGHT INTO USE *without any Mixture of Honey* [d]: for, tho it would not be ſo abſterſive and opening as Mead; yet it might be more grateful to the Stomach, more lenitive, and proper in ſharp Diſeaſes: for *Sugar* in Beer and Ale, has good Effects in ſuch caſes [e]. See the *Articles* PRSERVATION, and VEGETABLES.

SWEAT.

The Nature and Regulation of Sweating.

1. When a Perſon bathes in hot Water, there comes no *Sweat* on the Parts under Water; becauſe *Sweat* is a kind of Colliquation, made neither by an over-dry, nor an over-moiſt Heat: for Over-moiſture ſomewhat extinguiſhes Heat, as even hot Water will quench Fire; and an over-dry Heat ſhuts up the Pores. Hence Men will ſooner ſweat when covered, before the Sun, or Fire, than if they ſtood naked: and earthen Bottles, filled with hot Water, provokes Sweat in Bed, better than hot Bricks. Again, hot Water cauſes an Evaporation from the Skin; ſo as to ſpend the Matter in thoſe Parts under the Water, before it collects and iſſues in Sweat. Laſtly, Sweat comes more plentifully, if the Heat be increaſed by degrees, than if it be greateſt at firſt, or continued equal: for the Pores are better opened by a gentle Heat, than a more violent one; and, upon their opening, the Sweat iſſues more abundantly. Phyſicians, therefore, when they provoke Sweat in Bed, by Bottles filled with a Decoction of ſudorifick Herbs, might do well to make two degrees of Heat in the Bottles; and apply the leſs heated firſt, and after half an Hour, the hotter [f]. 2. *Sweat*

[d] *Angelus Sala* ſhews the Method of making a kind of Wine with *Sugar*, in his *Saccharologia*: but he had not the perfect Way; which is extremely ſimple and eaſy. This Subject, ſurely, would have been better cultivated, if MADE WINES, as they are called, did not lie under ſome Diſrepute: which, in part, proceeds from the unskilful and *coarſe* manner wherein they are generally prepared; and, in part again, from the Induſtry of certain Perſons, whoſe Intereſt it is to beget a Conſumption of *foreign Wines*.

[e] This is a Subject I have, myſelf, proſecuted with ſome diligence; and, perhaps, far enough to form an AXIOM or two upon it, that ſhall contain the Subſtance of ſeveral *new Arts*; or lead to the Improvement and Perfection of *Brewing*, *Wine-making*, *Vinegar-making*, *Diſtilling*, &c. The AXIOM here principally meant is this. *A Saccharine Subſtance, or real Sugar, is the Baſis of all Malt-liquors, Wines, Vinegars, and inflammable Spirits.* This *Axiom* is derived from a large, and, poſſibly, a competent number of particular *Experiments*, *Inſtances*, and *Obſervations*; after the *Inductive Method*: but they are too many to be here inſerted. It may deſerve a particular *Treatiſe*, to ſhew how all kinds of *Wines*, *Spirits*, and *Vinegars*, are procurable to great Advantage from *mere Sugar* and *Water*: A Doctrine that deſerves to be recommended to the *Sugar Colonies* Abroad, or certain Fabricators at Home. See the *Article* WINE.

[f] The Introduction of Bagnios has almoſt aboliſhed the Method of Sweating by Bottles: however the Rule holds good of Bagnios alſo; where the Heat is a Mixture of a dry Heat and a moiſt one; and increaſed by degrees. See the *Article* BATHING. 1

2. *Sweat* is ſaline to the Taſte; becauſe that part of the Nouriſhment which is freſh and ſweet, turns into Blood and Fleſh; and the Sweat is only a part ſeparated and thrown off. Raw Blood alſo has ſome ſaltneſs, more than Fleſh; becauſe the Aſſimilation into Fleſh happens not without a ſmall and ſubtile Excretion from the Blood [g]. *The Cauſe of Saltneſs in Sweat.*

3. *Sweat* comes more plentifully upon the upper-parts of the Body, than the lower; becauſe the upper-parts are more repleniſhed with Spirits: and the Spirits are what ſend out the Sweat. Beſides, thoſe Parts are leſs fleſhy: and Sweat iſſues chiefly out of the Parts that are dry and thin of Fleſh; as the Forehead and Breaſt [h]. *Why the upper-parts of the Body ſweat moſt.*

4. Men ſweat more in Sleep, than waking: yet ſleep rather checks, than promotes other Evacuations; as Rheums, Diarrhœas, *&c.* becauſe in Sleep the Heat and Spirits naturally move inwards, and there continue; but when they are once collected within, the Heat becomes more violent, and thence expels the Sweat [i]. *Why People ſweat moſt in Sleep.*

5. *Cold Sweats* are often mortal, and always ſuſpected; as in great Frights, hyſterick Diſorders, *&c.* for ſuch Sweats proceed from a Relaxation, or Deſertion of the Spirits; whereby the moiſture of the Body, which Heat kept firm in the Parts, ſeparates and flies off. *Cold Sweats.*

6. *Sweat* is hurtful in thoſe Diſeaſes that cannot be diſcharged by it; and in that caſe, ought rather to be ſtopped; as in Diſeaſes of the Lungs, and Fluxes of the Belly: but in thoſe Diſeaſes that are expelled by Sweat, it relieves and proves ſerviceable; as in Agues, peſtilential Fevers, *&c.* for here Sweat is partly critical, and drives out the offending Matter; but in the former Caſes, it either proceeds from the labour of the Spirits, which ſhews them oppreſſed; or from Motion of Conſent; when Nature, unable to expel the Diſeaſe where it is ſeated, moves to a general Expulſion over all the Body [k]. *Why Sweat is prejudicial in ſome Diſeaſes, and ſerviceable in others.*

[g] Here is the Foundation of a noble Enquiry into the Buſineſs of Sanguification, Aſſimilation, and Excretion: a Subject hitherto not proſecuted ſuitably to its Merits, nor the Intimations given for it by the Author.

[h] The *Miliary Glands* are, at preſent, made the principal *Organ of Sweat*; which lie diſperſed over the whole Surface of the Body, under the *Cutis*: and if theſe Glands are thicker ſet in ſome Parts than in others, as the *Forehead*, *Breaſt*, &c. and Sweat be moſt plentiful in theſe Parts, we have hence a nearer Approximation to the *Cauſe*.

[i] Obſerve here that kind of *Interpretation*, which applied to the human Body, is the principal Means of improving both *Phyſiology*, *Noſology*, and the whole Science of *Medicine*.

[k] This Subject ſeems to have been very ſparingly touched by *Phyſicians*; tho, certainly, a thing of great Conſequence in the Improvement of their Art. 'Tis true, *Sudoriſicks* are much in uſe; and Sweating is much practiſed; but a phyſical Knowledge of the Nature, Cauſe, and Effects of Sweat; with the beſt Methods of raiſing, governing, and directing it, in the Cure of certain Diſeaſes, appears to be ſtill wanting; tho, perhaps, our Author has here laid the Foundations for ſupplying it. But, we have frequent Occaſion to obſerve, there are few who follow his Steps.

SWELLING.

The Cauſe of Tumefaction in Bruiſes.

It has been obſerved, that Plates of Metal, and eſpecially of Braſs, preſently applied to a Contuſion, will keep down the Swelling [m]. The *Cauſe* is Repercuſſion, without Humectation, or entrance of a Body: for the Plate has only a virtual Cold; which does not ſearch into the Hurt, as all Plaiſters and Ointments do. The Reaſon why Blows and Bruiſes produce Swelling, is, becauſe the Spirits reſorting to aſſiſt the Part, draw the Humours along with them; for it is not the re-action, or return of the Humour into the Parts upon the Blow, that cauſes it; ſince the Gout and Tooth-Ach occaſion Swelling; where there is no Percuſſion at all [n]. See the *Article* PUTREFACTION.

SYMPATHY *and* ANTIPATHY.

The Importance of the Doctrine of Sympathy and Antipathy.

1. The *Agreements* and *Diſagreements* in Nature are the Spurs of Motions; and the Keys of Works: whence proceed the Union and Avoidence of Bodies; Mixture; Separation; the deep and intimate Impreſſions of Virtues; the Conjunction of active Bodies with paſſive; and, in ſhort, the capital Things of Nature. But this part of Philoſophy concerning the *Sympathy* and *Antipathy* of Things [o], otherwiſe call'd *Natural Magick*, appears exceedingly corrupted: tho, as is generally the Caſe, where Care has been wanting, there ſtill remain'd Hope. Whence the Operation of this Doctrine upon Mankind, has a perfect reſemblance with certain Narcotick Medicines; which, the ſame time they procure Sleep, cauſe pleaſing Dreams. For firſt, it has render'd the Underſtanding drowzy, by crying up *ſpecifick Properties*, *occult Virtues*, and *celeſtial Influences*; whence Men are no longer awake to the Diſcovery of *real Cauſes*, but indulge themſelves in idle Notions, and fall aſleep; at which Time, Hope inſinuates numerous Figments, like ſo many Dreams. And thus vain Men hope to underſtand Nature by her Front, And Perſon; or to diſcover internal Properties by external Reſemblances. and their Practice is exactly correſpondent to this hopeful Procedure: For the Precepts of *Natural Magick* are ſuch, as if Men truſted they could till the Ground, and eat their Bread, without any ſweat of the Brow; or become Maſters of every Thing by a few indolent and trifling Applications of one

[m] But is the Practice ſafe; eſpecially in large Contuſions?

[n] The *Cauſe* here aſſign'd, ſeems to regard *Contuſions*, and that kind of Swellings called by the Chirurgeons *humoural*; beſides which, there are ſeveral others, *viz.* O*Edematous*, *Scrophulous*, *Cancerous*, &c. the efficient Cauſes whereof are not perhaps, ſufficiently, known.

[o] Let no Diſtaſte be ſuddenly taken at the words *Sympathy*, and *Antipathy*: they mean the ſame as what we now call the *Laws of Nature*; only the Name being changed, whilſt the Thing remains the ſame. Thus, for Inſtance, the *Laws of Attraction and Repulſion*, might as ſignificantly be called the Laws of Sympathy and Antipathy. The Force of Words is very extraordinary; and ſhould, if poſſible, be reduced to a Law: they have, at preſent, the Power of making old Things become new, and new Things become old. Thus, if the preſent Philoſophy were put into ancient Language; there is Reaſon to believe it would loſe much of its Currency. And if any ancient, diſcarded Philoſophy were to be neatly dreſſed up, in new Words and Phraſes, there is Reaſon to believe it would have its Admirers: As in effect we find it often has had. This, if duly attended to, might ſerve to rectify a prevalent Error, or groſs Idol of the Mind.

one Body to another; then they have continually in their Mouths, and produce as Vouchers, on all occaſions, Magnetiſm, the Attraction betwixt Gold and Quickſilver, and a few more Obſervations of this kind, to gain themſelves a Credit in other Matters; where there is by no means the ſame Relation. But Nature offers all that is excellent, to be purchaſed by a laborious ſearch of the Mind, and Operation of the Body. We would, therefore, uſe our utmoſt Diligence in diſcovering the *Laws of Nature*, and *interpreting* the Alliances and Relations of Things; without giving into Miracles, on the one Hand, or proſecuting a narrow grovelling Enquiry, on the other [p].

The Appetite of Union in all Bodies, eſpecially of three kinds.

2. All Bodies have an Appetite of Union; and avoid a Solution of Continuity: and of this Appetite there are many degrees; but the moſt remarkable are three; the *firſt* in Liquors; the *ſecond* in hard Bodies; and the *third* in tenacious Bodies. In Liquors this Appetite is weak: as appears by their falling in Threads, or round Drops; and their Continuance, for a ſmall time, in the form of Bubbles and Froth. In the *ſecond* kind, this Appetite is ſtrong; as in Iron, Stone, Wood, *&c.* In the *third*, it is in a Medium, between the other two: for this kind of Bodies partly follow the touch of another, and partly ſtick and continue to themſelves; whence they rope and draw into Threads; as Pitch, Glew, Bird-lime, *&c.* But all ſolid Bodies are more or leſs cleaving: and affect the touch of ſomewhat tangible, rather than of Air. For Water, in a ſmall quantity, cleaves to any Thing that is ſolid; ſo would Metal if the Weight did not draw it off: for Leaf Gold, or any Metal foliated, will cling. But the Bodies noted for being clammy and cleaving, are ſuch as have a more indifferent Appetite, at once to follow another Body, and yet hold to themſelves: whence they are commonly Bodies ill mixed; that delight more in a foreign Body, than in preſerving their own Conſiſtence; and not greatly abounding in dryneſs or moiſture [q].

Obſervations of Sympathy and Antipathy with regard to medicinal Uſe.

3. 'Tis a *received Opinion*, that *Cantharides* applied to any part of the Body, come in Contact with the Bladder; and, if they remain long, exulcerate it [r]. 'Tis likewiſe *received*, that a kind of Stone, which they

[p] This was deſigned by the Author as an *Introduction* to a *particular Hiſtory of the Sympathy and Antipathy of Bodies*; after the ſame manner as the *Hiſtory of Winds, Life and Death*, &c. but the Hiſtory itſelf was never publiſhed. The Subject is certainly one of the principal in all *Phyſicks*; and well deſerving the Proſecution of Philoſophers. But in an Affair ſo dark, and, indeed, ſo little fitted to the Capacities of the generality, we could earneſtly wiſh for the Author's Direction. To have ſeen this noble Subject treated in his manner, like the Subject of Life and Death, for Example, might have ſhewn the direct way of perfecting the Enquiry; or even have nearly executed the full Deſign. But for the following Attempt, it is a mere *Sylva*, or Collection of Materials, Experiments and Obſervations, that want much trimming, and pruning, to fit them for entring a particular Hiſtory of *Sympathy* and *Antipathy*.

[q] This Doctrine is now commonly reſolved into *Attraction*; as if when that word can be applied, there were an End of Enquiry. But whoever conſiders the Phænomena, will find their *efficient Cauſes* no nearer being diſcover'd, ſince the modern Uſe of this Term than before. In ſhort, both the Terms, *Sympathy* and *Attraction*, ſeem uſed by the judicious, only to expreſs the Phænomenon; and not to aſſign the efficient *Cauſe*.

[r] Cantharides, tho externally applied, manifeſtly affect the Bladder; or give the Strangury: as appears by numerous Inſtances, in the Application of Bliſter-Plaiſters.

bring out of the *West Indies*, has a peculiar Virtue to diſſolve the Stone in the Bladder; and even if applied but to the Wriſt, to diſcharge Gravel violently [t]. 'Tis *received*, that the ſoals of the Feet have a great Conſent with the Head, and the Mouth of the Stomach: and we ſee that going wet-ſhod, to thoſe who are not uſed to it, will affect both. Applications of hot Powders to the Feet, firſt attenuate, and afterwards dry up the Rheum. And hence a Phyſician, to expreſs himſelf myſtically, preſcribed for the Cure of a Rheum; that a Man ſhould walk continually upon a *Camomile* Bed; meaning, that he ſhould wear Camomile in his Socks. Again, freſh bleeding Pigeons are applied to the ſoals of the Feet to eaſe the Head: and ſoporiferous Medicines, applied to the ſame, provoke Sleep. It ſeems, that as the Feet have a Sympathy with the Head, ſo the Wriſt and Hands have with the Heart. The Affections and Paſſions of the Heart and Spirits are remarkably diſcover'd by the Pulſe: and 'tis often found, that the Juice of Stock-July-Flowers, Garlick, and other Things, applied to the Wriſts, and renew'd, have cured inveterate Agues [u]. And I conceive, that waſhing the palms of the Hands with certain Liquors, may do good. It ſeems proper in the hot fit of an Ague, to hold in the hands Eggs of Alabaſter, and Balls of Cryſtal [v].

An Inſtance of Induration by Sympathy.

4. Make a little Cavity in the midſt of melted Lead, when it begins to ſet; and lodge Quickſilver therein, tied up in a piece of Linen; and the Quickſilver will fix, ſo as to endure the Hammer. This ſeems a noble *Inſtance* of Induration, by the conſent of one Body with another [w]; for it appears leſs reaſonable to aſcribe it only to the vapour of the Lead. *Quære*, whether Quickſilver may thus be ſo fix'd as to become figurable, like other Metals? For if ſo, Veſſels might be made of it, provided they come not near the Fire [x].

The ſecret Virtue of Sympathy and Antipathy, in Gems, and viſible Objects.

5. There are many Things that operate upon the Spirits of Man, by *ſecret Sympathy and Antipathy*. That precious Stones have Virtues in the wearing, has been anciently and generally received; and they are ſaid to produce ſeveral Effects. So much is true; that Gems have fine Spirits; as appears by their Splendour [y]: and therefore may operate, by Conſent, upon the Spirits of Men, to ſtrengthen and exhilarate them. The beſt Stones for this purpoſe are the Diamond, the Emerald, the Hyacinth, and the yellow

[t] This Stone does not at preſent maintain its Character.

[u] A proper Collection of this kind of Effects, well verified by repeated Trials, ſeems hitherto wanting; in order to lay a firm Foundation for a *Sympathetick Philoſophy*; with regard to *Medicine*.

[v] See this Subject farther proſecuted by Mr. *Boyle*, in his *Diſcourſe of Specifick Remedies*.

[w] Does the Author here mean that the Quickſilver fixes by Conſent, as the Lead fixes? Or, to ſpeak more intelligibly, tho leſs accurately, that the Quickſilver fixes becauſe the Lead fixes? If this be the meaning, let it be tried, whether Quickſilver will not *ſometimes* fix, by being ſuſpended over melted Lead; whilſt the Lead itſelf remains fluid.

[x] The common Experiment of making a Counterfeit Gold with Quickſilver, and Roman Vitriol, if it were not Contingent, might prove highly ſerviceable. And I have ſeen a yellow Metal of this kind, that might have eaſily impoſed upon the Vulgar.

[y] Is this a neceſſary Conſequence? But let it be conſider'd, that Glaſs and Gems have a Power of reflecting Light, before it actually touches their Surface.

low Topaz [y]. As for their particular Properties, no Credit can be given to them. But 'tis manifeſt, that Light, above all Things, rejoices the Spirits of Men: and, probably, varied Light has the the ſame Effect, with greater Novelty: which may be one Cauſe why precious Stones exhilerate. It were, therefore, proper to have tinged Lanthorns, or skreens of Glaſs, colour'd Green, Blue, Carnation, Crimſon, Purple, *&c.* and to uſe them with Candles in the Night: ſo likewiſe to have round, colour'd Glaſſes, that are ſtained thro'; or to have Colours laid between Cryſtals, and Handles to hold them by. Priſms, alſo, are pleaſant Things. There are Looking-glaſſes, common at *Paris*, with broad Borders of Cryſtal; and large counterfeit Gems, of all Colours, that are very pleaſant to the Eye; eſpecially in the Night. The Pictures of *Indian* Feathers are likewiſe pleaſing: and clear Streams recreate the Eyes and Spirits, eſpecially by Moon-ſhine, or when the Sun is over-caſt.

6. There are ſeveral ſorts of Bracelets to comfort the Spirits; and of three Intentions, *viz. Refrigerant*, *Corroborant*, and *Aperient*. (1.) The *Refrigerant* may be of a Pearl, or Coral: and it has been noted of Coral, that if the Perſon who wears it, be indiſpos'd, it will turn pale; which may be true, becauſe a hot Diſtemper makes it loſe its Colour. I recommend alſo Beads, or little Plates, of *Lapis Lazuli*; and Beads of Nitre, either alone, or with ſome Cordial Mixture. (2.) For *Corroboration*, take ſuch Bodies as are Aſtringent, without a manifeſt Coldneſs; as Bead-Amber, which is full of Aſtriction; yet unctuous, and ſomewhat warm. I recommend likewiſe Beads of Hartſhorn and Ivory, which are of the like Nature; alſo Orange-Beads; and Beads of *Lignum Aloes*, firſt macerated in Roſe-water, and dry'd. (3.) For *opening*, I recommend Beads of the Roots of *Carduus Benedictus*; the Roots of Male Piony; Orrice; *Calamus Aromaticus*; and of Rue [z]. *Bracelets of three kinds.*

7. The *Cramp* is probably a Contraction of the Sinews; as appears from its coming either by Cold or Dryneſs; as after Conſumptions, and long Agues: for Cold and Dryneſs, both contract and corrugate. We ſee alſo, that chafing a little above the Part in Pain, eaſes the Cramp; by warming and dilating the contracted Sinews. There are two things in uſe to prevent the Cramp; *viz.* Rings of Sea-Horſe Teeth worn upon the Fingers; and Fillets of green Periwinkle, tied about the Calf of the Leg, the Thigh, *&c.* where the Cramp uſually comes. This ſeems the more ſtrange, becauſe neither of them has any relaxing Virtue, but rather the contrary: Whence they appear to operate rather upon the Spirits in the Nerves, than upon the Subſtance of the Nerves themſelves [a]. *The Cauſe and Cure of the Cramp by external Applications.*

8. Light

[y] See Mr. *Boyle* upon the *Origin and Virtues of Gems.*

[z] There ſeem not to have been ſufficient Trials made of theſe Things; in order to form a valid Judgment upon them.

[a] The Terms *Nerves* and *Sinews* ſeem to be here uſed as convertible: but in the anatomical Senſe, they are widely different; the Sinews being properly not *Nerves*, but the *Tendons of the Muſcles*: and in this Senſe, an involuntary Contraction of the Tendons, or rather, perhaps, of the Belly of a Muſcle, may be the Cauſe of the Cramp, or the actual Cramp itſelf.

An imperfect Axiom form'd upon it.

8. Light may hence be derived, to ſhew how Things which ſtop the ſtruggle of the Spirits, help in Diſeaſes, contrary to the Intention: for in curing the Cramp, the Intention is to relax the Sinews; but the Contraction of the Spirits, that they may ſtruggle leſs, is the beſt Remedy. So, to procure eaſy Travail, the Intention is to bring down the Child; but the beſt help is, to prevent its coming down too faſt. So, in peſtilential Fevers, the Intention is to expel the Infection, by Sweat and Exhalation; but the beſt means to do it is by Nitre, and other cool Things; which for a time arreſt the Expulſion, till Nature can effect it more quietly. It ſeems to be an excellent AXIOM, and of great Uſe, that *whatever appeaſes the Struggle of the Spirits, promotes their Action* [b].

Whence the Virtue of Piony in the Epilepſy.

9. It has been long received, and confirmed by Trial, that the dried Root of the *Male-Piony*, tied to the Neck, helps in the Falling-Sickneſs; and likewiſe in the *Incubus* or *Night-Mare*. The *Cauſe* of both theſe Diſeaſes, and eſpecially the Epilepſy, may be the groſſneſs of the Vapours from the Stomach; which riſe and enter the Cells of the Brain: ſo that the Effect is here perform'd by the extreme and ſubtile attenuating Virtue of the Simple. I judge the like of *Caſtor*, *Muſk*, *Rue-Seed*, the Seed of *Agnus Caſtus*, &c.

Inſtances of Virtue in Bodies wore externally.

10. To wear the Blood-ſtone, is thought good againſt bleeding at the Noſe: and may have its Effect by aſtringing and cooling of the Spirits. It has been anciently received (for *Pericles* uſed it) and is ſtill practiſed, to wear little Bladders of Quickſilver, or Tablets of Arſenick, as Preſervatives againſt the Plague: not for any aſſiſtance they yield the Spirits, but becauſe, being Poiſons, they attract the Malignity [c].

Inſtances of Sympathetical Effects on different Creatures.

11. We ſee Scare-Crows are ſet up, to keep Birds from Corn and Fruit; and 'tis *reported*, that the Head of a Wolf, dried and hung up in a Dove-houſe, will frighten away Weaſles, Polecats, *&c.* and perhaps the Head of a Dog will do as much; for thoſe Vermine with us, know Dogs better than Wolves.

Brains eaten to ſtrengthen the Memory.

12. The Brains of ſome Creatures roaſted, and taken in Wine, are ſaid to ſtrengthen the Memory; as the Brains of Hares, Deers, *&c.* And this ſeems peculiar to the Brains of thoſe Creatures that are fearful [d].

The Ointment of Witches.

13. The Ointment of Witches, is reported to be made of the Fat of Children, dug out of their Graves; the Juices of Smallage, Wolfsbane and Cinque-

[b] This intimates a method of interpreting Nature, for the perfecting of Practice; which Philoſophers make ſo little Uſe of, that it ſhould ſeem they do not know there is any ſuch Method practicable to Advantage. And when they will be ſenſible of it, ſo as to endeavour the improvement of Medicine by its means, is uncertain. To talk of forming *Aphoriſms*, *inveſtigating Cauſes*, and raiſing *Axioms*, is talking in a Language almoſt unknown; and yet, unleſs theſe Things be procured, neither Philoſophy nor Medicine can be conſiderably improved.

[c] The wearing of *Arſenick*, in the way of Amulet, having had poiſonous Effects, is now juſtly laid aſide. The practice has been common in times of the Plague; and is ſaid to have ariſen chiefly from an ignorance of *Arabick*; the word in the *Arabian* Authors which is render'd *Arſenick*, properly ſignifying *Cinnamon*.

[d] Little Credit can be given to theſe Relations, for any thing that has hitherto been approved upon competent Experience.

Cinquefoil, mix'd with fine Wheat-Flower. But, I ſuppoſe, the ſoporiferous Simples, are fitteſt for this Purpoſe; ſuch as, *Henbane*, *Hemlock*, *Mandrake*, *Moonſhade*, *Tobacco*, *Opium*, *Saffron*, &c.

The Diet of pregnant Women affects the Infant.

14. It has been obſerved, that the Diet of Women with Child affects the Infant; ſo, for the Mother to eat Quinces, and Coriander-Seed, in large Quantities, which repreſs Vapours that would aſcend to the Brain, makes the Child ingenious: and, on the contrary, to eat largely of Onions, Beans, or ſuch flatulent Food; to drink Wine, or ſpirituous Liquors immoderately; to faſt much; or be given to muſing; all which ſend Vapours to the Head; endangers the Child's becoming Lunatick, or of weak Memory. And I judge the ſame of Tobacco often taken by the Mother [e].

Effects of a Hedge-Hog's Fleſh.

15. The Fleſh of a Hedge-hog dreſs'd and eaten, is ſaid to be a great drier: and indeed the Juice of a Hedge-hog, ſhould ſeem to be harſh and dry; becauſe it puts forth ſo many Prickles. For *Plants that are full of Prickles prove generally dry: as Briars, Thorns, Barberries*, &c. [f] and hence the Aſhes of a Hedge-hog are ſaid to be a great Deſiccative in Fiſtula's.

The Styptick Virtue of Mummy *and Skull Moſs.*

16. *Mummy* has a great Virtue to ſtop Bleeding; which may be aſcribed, in ſome meaſure, to its mixture of Balſams that are glutinous; and alſo to a *ſecret Property*; becauſe the *Blood attracts Man's Fleſh*. And 'tis approved that the Moſs growing upon an unburied Skull, ſtops Blood powerfully: ſo does the Powder of Blood, ſeparated from the Serum, and dried [g].

That Blood attracts Salt.

17. *'Tis reported*, that the white of an Egg, or Blood, mix'd with Salt-water, collects the Saltneſs; and makes the Water ſweeter. This may be effected by Adheſion; as in Clarification. Perhaps alſo Blood, and the white of an Egg, have ſome Sympathy with Salt: as all Life has. We ſee that Salt applied to a cut Finger heals it; whence Salt appears to attract Blood, as well as Blood attracts Salt. [h].

The Antipathy of the Sea-Hare to the Lungs.

18. It has been *anciently received*, that the *Sea-hare* hath an *Antipathy* to the Lungs; ſo as if it comes near the Body to corrode them. The *Cauſe* is conceived to be, a quality the Hare has of heating the Breath and Spirits; as *Cantharides* operate upon the watry Parts of the Body. And 'tis a good Rule, that *whatever operates upon a certain kind of Matter, operates moſt upon thoſe Parts of the human Body, which abound with that kind of Matter* [i].

19. What

[e] Theſe Particulars require better Confirmation.

[f] Theſe larger Obſervations which offer at a juſt Interpretation of Nature, or Attempts for the raiſing of *Axioms*, cannot be too carefully noted; as well for their own ſakes, as the Example they hold out, of the End to which all phyſical Enquiries ſhould be directed.

[g] There is ſomething extraordinary intimated here: but we dare not pronounce upon it, for want of a ſufficient number of competent *Experiments*.

[h] Does Blood attract Salt by any other than its aqueous Part? There are other Queries to be propoſed upon this Head; but for our own part, we had rather riſe up to make Experiments, than ſit down to ask Queſtions: and to ſay the Truth, Experiments are the only Anſwers of any ſignificance in all theſe Caſes, for Conjectures, and Talk, and Reaſoning, without them are childiſh and impertinent Things.

[i] I would willingly avoid an over-officiouſneſs in pointing out the more fundamental Parts of this *Piece*: but the numerous AXIOMS latent in it, have been ſo little regarded, and Philoſophers are uſually ſo little acquainted with the infinite Uſe of *Canons*, *large Obſervations*, and *Axioms*, that 'tis in a manner neceſſary to indicate them as often as they occur.

The Antipathy in living Bodies to dead ones; and found ones to corrupted.

19. What is dead, corrupted, or voided, has generally an *Antipathy* with the ſame thing alive, or ſound; and with the diſcharging Parts: thus the Carcaſs of a Man is moſt infectious and odious to a Man; the Carrion of a Horſe to a Horſe, *&c.* purulent Matter, Ulcers, Carbuncles, Scabs, *&c.* to ſound Fleſh; and the Excrement of every Species to the Creature that diſcharges them: but Excrements are leſs pernicious than Corruptions. 'Tis a common Obſervation, that Dogs know the Dog-killer: for when in times of Infection, ſome petty Fellow is ſent out to kill the Dogs; tho they have never ſeen him before, yet they will all come out and bark and fly at him [k].

Whether the Minds of Men may have ſecret Notices of Events.

20. The Relations as to the *Force of Imagination*, and the *ſecret Inſtincts of Nature*, are ſo uncertain, that they require a deal of Examination, before we conclude upon them. I would have it thoroughly examined whether there be any ſecret *Paſſages of Sympathy*, between Perſons near in Blood; as Parents, Children, Brothers, Siſters, Husbands, Wives, *&c.* There are many *Reports* in Hiſtory, that upon the Death of Perſons nearly related, Men have an inward feeling of it. I myſelf remember, that being at *Paris*, and my Father dying in *London*, I had two or three Days before his Death, a Dream, which I told to ſeveral *Engliſh* Gentlemen; that my Father's Houſe in the Country was plaiſter'd all over with black Mortar [l]. There is an *Opinion* abroad, whether idle or no, I cannot ſay; that affectionate and tender Husbands have a Senſe of their Wives breeding, by ſome Accident in their own Body [m].

Whether an intermediate Perſon may have theſe Notices.

21. Next to thoſe near in Blood, there may be the like Paſſage, and Inſtincts of Nature, between great Friends and Enemies: and ſometimes the Notice is given to a ſecond Perſon. *Philip de Commines*, a grave Writer, reports, that the *Archbiſhop of Vienna* ſaid, one Day after Maſs, to *Lewis* the XIth of *France*: *Sire, Your mortal Enemy is dead*; at which time, *Charles* Duke of *Burgundy* was ſlain in the Battle of *Granſon* againſt the *Switz*. Trial alſo ſhould be made, whether Compact or Agreement has here any Effect; as if two Friends ſhould agree, that ſuch a Day in every Week, they being in diſtant places, ſhould pray for each other; or put on a Ring for each others Sake; to try whether if one ſhould break his Promiſe, the other would have any feeling of it, in Abſence [n].

22. If

[k] This is a pregnant Aphoriſm, and an extenſive Obſervation to the preſent purpoſe; that from direct Phænomena, ſearches deep into Nature.

[l] It is certainly difficult for Men educated in the common way, to enquire ſtrictly and philoſophically into this part of the preſent Subject. The Mind ſeems almoſt to dread it; as if fearful of diſcovering more than Reaſon is willing to allow.

[m] Such Particulars as theſe ought to be diligently enquired after, if we deſire to have any tolerable Knowledge of the Subject in Hand; but few Philoſophers are able to keep their Countenance at the mention of them.

[n] Theſe Experiments have not, perhaps, been made; at leaſt not by the proper Perſons; who ſhould, doubtleſs, be Men or Women of ſtrong Faith, or Imagination: but then they ſhould alſo be Perſons of great Veracity; or join Men of more Solidity along with them: otherwiſe we might be eaſily impoſed upon. And to ſay the Truth, Experiments of this kind are attended with great difficulty and uncertainty. For the Method of facilitating and rendring them more ſtable, See the *Article* IMAGINATION.

22. If there be any Force in the Imaginations and Affections of ſingle Perſons; it is probably much greater in the joint Imaginations and Affections of Multitudes. If a great Battle ſhould be won or loſt in a remote Country, is there not ſome Senſe thereof in the People it concerns; becauſe of the great Joy, or Grief, that Men are ſometimes poſſeſſed with at once? *Pius Quintus*, at the very time that memorable Victory was gained by the Chriſtians againſt the *Turks*, in the Sea-fight of *Lepanto*, being then hearing Cauſes in the *Conſiſtory*, broke off ſuddenly, and ſaid to thoſe about him, *it is now rather time that we ſhould give Thanks to God, for the great Victory he has granted us againſt the* Turks. 'Tis true, that Victory had a *Sympathy with his Spirit*; for it was merely his Work to conclude the Treaty. It may be this Revelation was Divine: but what ſhall we ſay to a number of Examples among the *Grecians* and *Romans*; where the People being in the Theatre, have had News of Victories and Overthrows, ſome Days before any Meſſenger could arrive [o]? The general Root of Superſtition may indeed hold in theſe Things; *viz. that Men obſerve when Matters hit, but not when they miſcarry:* and commit the one to Memory, but forget the other.

Examples for operating by the Imagination in Animals.

23. We have already laid down ſome Rules for making Experiments upon the Power of *Imagination*; and added ſome Means of fortifying it; together with a few Directions and Inſtances of its Force upon Beaſts, Birds, Plants, and inanimate Bodies [p]: conſtantly requiring that the Trials be only made upon ſubtile and light Motions; for you will ſooner, by Imagination, bind a Bird from ſinging, than from eating or flying: and I leave every Man, to chuſe the Experiments, which himſelf thinks moſt commodious. But to add a few Examples; obſerve to uſe ſome Imaginant, according to the former Rules; for binding a Bird from ſinging, or a Dog from barking. Try alſo the Imagination of Perſons whom you ſhall accommodate with Things to fortify it, as in Cock-fightings, to make one Cock more courageous, and the other more cowardly. Try it alſo in the flying of Hawks, chaſing of Deer, Horſe-Races, and the like comparative Motions: for 'tis eaſier by Imagination to accelerate, or check a Motion, than to raiſe, or ſtop it; as 'tis eaſier to make a Dog go ſlower, than to make him ſtand ſtill.

In Plants and inanimate Bodies.

24. In Plants alſo, let the Force of Imagination be tried upon the lighter ſort of Motions: as upon the ſudden fading, or lively vegetation of Herbs; or upon their bending one way or other; or upon their cloſing and opening, *&c.* And in Things inanimate, try the Force of Imagination, upon ſtopping the working of Beer, when the Yeaſt is put to it; or upon the coming of Butter, or Cheeſe-Curd, after the Cherning, or the addition of the Rennet.

[o] But might not theſe be State-Artifices; uſed to feel the Pulſe, or raiſe the Spirits of the People?

[p] See the *Article* IMAGINATION.

The benumbing Faculty of the Torpedo.

25. 'Tis every where alledged as an Example of *ſecret Properties and Influences*, that the *Torpedo*, if touched with a long Stick, ſtupefies the Hand [q]. And 'tis one degree of working at a Diſtance, to work by the Continuation of a fit Medium: thus, Sound will be convey'd to the Ear, by ſtriking upon a Bow-ſtring, if the Horn of the Bow be held to the Ear.

The Parts of Animals may have more Virtue if ſeparated from them Living.

26. The Writers of *Natural Magick* attribute much to the Virtues remaining in the parts of Animals, if taken from them alive: as if the Creature in that Caſe infuſed ſome immaterial Virtue, or Vigour, into the ſeparated part. So much may be true, that any part taken from a Creature newly killed, may be of greater Force, than if taken from the like Creature dying of itſelf; as being fuller of Spirit.

Trials to be made by ſeparating the Parts of Individuals.

27. Trial ſhould be made in the like parts of Individuals; as by cutting off part of the Stock of a Tree, and laying it to putrefy; to ſee whether this will decay the reſt of the Stock: or cutting off part of the Tail, or Leg of a Dog or Cat, and laying it to putrefy; to ſee whether this will keep the other part from Healing.

Love Tokens.

28. 'Tis ſuppoſed, a help to the Continuance of Love, to wear a Ring, or Bracelet of the Perſon beloved: but this may proceed from exciting the Imagination; which perhaps a Glove, or other the like Favour might do as well.

The ſtroking of Warts.

29. The *Sympathy of Individuals*, that have been entire, or in Contact, is of all others the moſt incredible. To take away Warts, by rubbing them with ſomewhat that is afterwards put to conſume, is a common Experiment. I had from my Childhood a Wart upon one Finger: afterwards when I was about ſixteen, being then at *Paris*, there grew upon both my Hands a number of Warts, at leaſt a hundred, in a Month's Time. The *Engliſh* Embaſſador's Lady, who was far from Superſtition, told me, ſhe would get away my Warts: and in order to it, ſhe rubbed them all over with the fat ſide of a piece of Bacon, with the Rind on; and among the reſt, the Wart, I had from my Childhood: then nail'd the Bacon, with the Fat towards the Sun, upon a Poſt of her Chamber-Window, which was to the South: and in five Weeks time the Warts went quite away; and the Wart I had ſo long endured, for Company. At the reſt I did not much wonder; becauſe as they came in a ſhort time, they might go away ſo too: but the vaniſhing of that which had remained ſo long, ſticks with me. They ſay, the like is done by rubbing Warts with a green Elder-ſtick; and burying the Stick. The Experiment might be tried on Corns, Wens, and other Excreſcences. I would have it alſo tried on ſome Parts of living Creatures, that approach neareſt to Excreſcences; as the Combs and Spurs of Cocks, the Horns of Beaſts, *&c.* And let it be tried, both by rubbing thoſe Parts with Bacon or Elder; and by cutting off ſome piece of them, and burying it: to ſee whether this will have any Effect towards conſuming the part once join'd with it [r].

30. 'Tis

[q] Does the Stupefaction cauſed by the touch of the *Torpedo*, proceed from any thing more than a particular Motion, whereby the Creature lets itſelf off, as it were, upon being touched? See a curious Paper upon this Subject in the *French Memoirs*.

[r] There are many Experiments of this kind related; but no proper Collection of them made, with the requiſite Care for forming a juſt Rule, or ſolid Judgment, upon them.

30. 'Tis *conſtantly avouched*, that to anoint the Weapon which gives the Wound, will heal the Wound itſelf. In this Experiment, which I have upon the relation of credible Perſons, tho I am not fully inclined to believe it, 'tis obſerved, (1.) That the Ointment employ'd conſiſts of ſeveral Ingredients; whereof the ſtrangeſt and hardeſt to procure, are the Moſs growing upon the Skull of a dead Man unburied, and the Fat of a Boar, and a Bear, kill'd in the Act of Generation. *The two laſt I could eaſily ſuſpect preſcribed as a Loop-hole; that if the Experiment did not ſucceed, it might be pretended the Beaſts were not kill'd at the right Time*; but for the Moſs, there is a great quantity of it in *Ireland*, upon ſlain Bodies, laid on Heaps, unburied. The other Ingredients are, Blood-ſtone in Powder, and ſome Things, which ſeem to have a Virtue to ſtanch Blood; as the Moſs alſo has. The Deſcription of the whole Ointment is found in *Crollius*'s Chemical Diſpenſatory. (2.) The ſame kind of Ointment applied to the Wound itſelf, has not the Effect; but only when applied to the Weapon. (3.) They do not obſerve to prepare the Ointment under any certain Conſtellation; ſo have not the Excuſe made for the failure of magical Medicines. (4.) It may be applied to the Weapon, tho the Perſon hurt be at a great Diſtance from it. (5.) It ſeems, the Imagination of the Perſon to be cured is not neceſſary; for it may be done without the Knowledge of the wounded: and it has been tried, that if the Ointment be wiped off the Weapon, without the Knowledge of the Patient, he is preſently in violent Pain, till the Weapon be re-anointed. (6.) 'Tis affirm'd, if the Weapon cannot be procured, and an Inſtrument of Iron, or Wood, reſembling the Weapon, be put into the Wound, ſo as to make it bleed; the anointing of that Inſtrument will have the Effect. *This I ſuſpect is a Device to keep ſo ſtrange a form of Cure in Requeſt and Uſe: becauſe many times one cannot procure the Weapon itſelf.* (7.) The Wound muſt be firſt waſh'd clean with White-wine, or the Perſons own Urine; and then bound up cloſe with fine Linen: and no more Dreſſing is required. (8.) The Weapon itſelf muſt be wrapped up cloſe, as far as the Ointment goes, that it takes no Wind. (9.) The Ointment, if wiped off from the Weapon, and kept, will ſerve again; and rather increaſe in Virtue than diminiſh. (10.) It cures in far ſhorter time than vulnerary Ointments commonly do. (11.) It cures a Beaſt as well as a Man; which ſubjects the Matter to an eaſy Trial [f].

The Weapon-ſalve.

31. The Delight we take in Popularity, Fame, Honour, the ſubduing and ſubjecting other Mens Minds, Wills or Affections, ſeems in itſelf, without regard to Conſequences, grateful and agreeable to the Nature of Man. This ſurely is not without ſome Signification; but ſeems as if the Spirits and Souls of all Men, came out of one divine *Limbus*: elſe why ſhould we be ſo much affected with what others think or ſay? The beſt Temper of Mind deſires a good Name, and true Honour; the lighter ſort, Popularity and Applauſe:

The general Sympathy of Mens Spirits.

[f] Thoſe who deſire farther Information upon this extraordinary Head, may conſult Sir *Kenelm Digby*, and Mr. *Boyle*.

the more depraved, Subjection and Tyranny; as we ſee in great Conquerors and Diſturbers of the World; and yet more in Arch-hereticks: for the introducing of new Doctrines, is an affectation of Tyranny over the Underſtandings and Opinions of Men [t].

T.

TEETH.

The Tenderneſs of the Teeth, whence.

THE Teeth are more affected by Cold, in drinking cold Liquors, or the like, than other Parts; becauſe Reſiſtance of Bone to Cold, is greater than that of Fleſh: for Fleſh ſhrinks, but Bone reſiſts; whereby the Cold becomes ſharper. Again, the Teeth are without Blood; but Blood helps to qualify Cold: whence the Sinews are much affected with Cold, as being Parts without Blood. So the Bones, in ſharp Cold, grow brittle; and therefore all Contuſions of the Bones are harder to cure, in froſty Weather [u]. See the *Article* BONES.

TIME.

The contrary Operations of Time upon Fruits and Liquors.

Time changes Fruits from ſour to ſweet; but potable Liquors from ſweet to ſour. The *Cauſe* is, the collection of the Spirits together; for in both kinds the Spirit is attenuated by time: but in the firſt 'tis more diffuſed, and ſubdued by the groſſer Parts, which the Spirits only digeſt; whilſt in Drinks the Spirits reign, and finding leſs oppoſition of the Parts, become themſelves more ſtrong, and thus ſtrengthen the Liquor: ſo that if the Spirits be of the hotter ſort, the Liquor becomes apt to burn; but in time, when the higher Spirits are evaporated, it cauſes likewiſe more Sourneſs [v].

TITILLATION.

The Cauſe of Titillation.

Tickling is moſt felt in the Soles of the Feet, under the Arm-pits, and on the Sides; from the thinneſs of the Skin, joined with the ſeldomneſs of being

[t] Tho the Materials here collected, are no way ſufficient to build up a *Sympathetical Philoſophy*; yet they may, perhaps, afford many Intimations and Directions for one. Certainly there are, in Nature, great numbers of *Phænomena*, and *Effects*, not to be accounted for upon *Mechanical Principles*; or the vulgar Doctrine of *Matter and Motion*: but require ſublimer Solutions. Whence proceeds the Influence and Aſcendency which one Man's Mind has over another: whence the Attractions, Repulſions, and more ſecret Relations in Bodies; of which the Inſtances are numerous; particularly in the Doctrine of *Menſtruums*? If proper Collections were made, of the more capital *Inſtances* of this kind; if the common *Sympathetic Experiments* were repeated with Care and Judgment, and their Number enlarged; if the common Traditions upon this Subject were ſifted and purged; and laſtly, if a Set of judicious and experienced Philoſophers were, for ſome time, employ'd in this Way; we ſhould then ſee whether a Harveſt of ſerviceable *Canons*, and *Axioms* might not be reaped, for extending, improving, and perfecting the *common Phyſicks*; which, for want thereof, appears but a lifeleſs Thing.

[u] Senſation is uſually denied to Bone; any farther than the Nerves are affected by its means.

[v] The due ſettling of this Point depends upon a Knowledge of *Fermentation* and *Acetification*. See *Boerhaave's Chemiſtry*, and *Stahl's Zymotechnia*.

being touched in thoſe Parts: for all tickling is a light Motion of the Spirits, promoted by the thinneſs of the Skin, and the ſuddenneſs and unfrequency of Touch: ſo a Feather tickles by being drawn along the Lip, or Cheek; but not a thing more obtuſe, or a ſtronger Touch. As to Suddenneſs; we find no Man can tickle himſelf: and the Palm of the Hand, tho it has as thin a Skin as the Parts above-mentioned, yet is not tickliſh; becauſe accuſtomed to be touched. Tickling alſo cauſes Laughter; perhaps from the emiſſion of the Spirits, and ſo of the Breath; for, upon tickling, there is always a ſtarting, or ſhrinking away of the Part, to avoid it: and if the Noſtrils be tickled with a Feather, or Straw, it procures Sneezing; which is a ſudden emiſſion of the Spirits, that, likewiſe, expel the Moiſture. And tickling is always painful, and not well to be endured [w]. See the *Article* VENERY.

TOBACCO.

The Means of meliorating Tobacco.

Tobacco is a thing of great Profit, if it be in requeſt; tho the Charge of making the Ground, and otherwiſe, is conſiderable: but the *Engliſh* Tobacco has little Reputation; as being too dull and earthy. So that, to render Tobacco more aromatic, and better concocted, here in *England*, might be a very beneficial thing. Some have attempted it by drenching *Engliſh* Tobacco in a Decoction of the *Indian:* but ſuch Methods are Sophiſtications and Toys; for NOTHING THAT IS ONCE PERFECT, AND HAS RUN ITS COURSE, CAN RECEIVE MUCH AMENDMENT. *We* MUST EVER RESORT TO THE BEGINNINGS OF THINGS FOR MELIORATION [x]. The Way of ripening Tobacco muſt, as in other Plants, proceed from the heat, either of the Earth, or the Sun. We ſee ſomething of this kind practiſed in Muſk-melons, which are ſown in a hot Bed, expoſed to the South-ſun, and laid upon Tiles, to increaſe the Heat by Reflexion; and covered with Straw, to defend them from the Cold. They alſo remove them; which adds ſome Life: and by ſuch Helps the Melons become as good in *England* as in *Italy*, or *Provence*. Theſe, and the like Means, may be tried in Tobacco. Enquire alſo, of ſteeping the Roots in a Liquor that may give them Vigour to put forth ſtrongly [y].

TONGUE.

Whence the Tongue gives early Signs of Diſeaſes.

The Tongue more eaſily receives Impreſſions, and affords more Tokens of Diſeaſes, than other Parts; as of Heats within, which appear moſt in the blackneſs of the Tongue. And pied Cattle are ſpotted in their Tongues, from the tenderneſs of the Part; which thence receives all Alterations more eaſily, than other parts of the Fleſh [z]. TRANS-

[w] This Article belongs to a ſublimer *Anatomy* than the common.

[x] Theſe are two AXIOMS of great importance; and, if well explained, might afford much light in the conducting of Works; and the introducing of Meliorations.

[y] There ſeems to be no great Occaſion, at preſent, for cultivating *Tobacco* in *England*; otherwiſe the Method, perhaps, is no Secret; being ſucceſsfully practiſed in the South parts of *France*.

[z] Some Indications are taken from the Tongue in Diſtempers; but the *Interpretations* of its Signs are not well ſettled.

TRANSMUTATION.

That Air preys upon Moiſture.

1. The Eye of the Underſtanding is like the Eye of the Senſe: for as large Objects are viſible thro' ſmall Chinks; ſo are great AXIOMS *of Nature* thro' ſmall and ordinary Inſtances[a]. The quick Depredation which Air makes upon watry Moiſture, and its converting the ſame into Air[b], appears in nothing more plain than in the ſudden Diſſipation of the little Cloud, made by breathing upon a Glaſs, a Sword-blade, or any ſuch poliſhed Body that does not detain, or imbibe the Moiſture; which here ſcatters and breaks up ſuddenly: whereas, the like Cloud remains long, if it were oily or fat; not becauſe it ſticks faſter, but becauſe it is *Air that preys upon Water*; *and Flame and Fire, upon Oil*[c]: whence, to take out a Spot of Greaſe, we uſe a Coal upon brown Paper; for Fire operates upon Greaſe, as Air does upon Water: and we ſee oiled Paper, or oiled Wood, will long remain moiſt; but grow dry, or putrefy ſooner, when wet with Water: for Air has little effect upon the Moiſture of Oil[d].

The force of Union to be ſubdued in Converſions.

2. The ſame trifling Inſtance of the little Cloud upon Glaſs, Gems, *&c.* admirably ſhews how much the Force of Union, even in the leaſt Quantities, and weakeſt Bodies, conduces to preſerve the preſent, and reſiſt a new Form. For this little Cloud conſtantly breaks up firſt in the Skirts, and laſt in the middle. We ſee likewiſe, that much Water draws out the Juice of a Body infuſed therein; whilſt little Water is imbibed by the Body: and this is a principal *Cauſe*, why, in Operations upon Bodies for their Alteration, Trials, in large Quantities, do not anſwer to the Trials in ſmall; and ſo impoſe upon many: for the greater the Body, the more it reſiſts any Alteration of Form; and requires much more Efficacy in the active Body, that ſhould ſubdue it[e].

The Means of producing Animals of uncommon Colours.

3. Anoint Pigeons, or other Birds, when in their Down; or very young Whelps, *&c.* firſt cutting their Hair as ſhort as poſſible, with ſome innocent Ointment that will harden, and ſtick very cloſe; to try whether it will not alter the Colour of the Feathers, or Hair. Pulling the firſt Feathers of Birds clean off, is ſaid, to make the new come white: and, 'tis certain, *White is a penurious Colour, that riſes where Moiſture is deficient*[f].

So

[a] A due Collection of which *Inſtances*, is the readieſt and ſureſt way of forming ſuch AXIOMS.

[b] Whether this be an Inſtance of the actual converſion of Water into Air, may be queſtioned. How does the Experiment ſucceed *in Vacuo*?

[c] Is Water the *Pabulum* of Air; as Oil is of Fire?

[d] More than one great *Axiom of Nature* is here intimated, that cannot perhaps be juſtly formed, without a farther Improvement of *Chemiſtry*; particularly that Part thereof which relates to the common Elements; or grand Inſtruments of the Art. See *Boerhaave's Chemiſtry*; but particularly, the Chapters of *Fire*, *Air*, *Water*, *Earth*, and *Menſtruums*; which are conſiderably improved in his own *Edition*.

[e] Here again are the Rudiments of an *Axiom*; containing great light of Information, in the conducting of Works, and the Buſineſs of *Tranſmutation*.

[f] This is a large, or very extenſive *Obſervation*; as may appear by the ſubſequent Inſtances, from which it ſeems to have been drawn.

So blue Violets, and other Flowers, if ſtarved, turn pale and white: Birds, and Horſes, by Age, or Scars, turn white: and the hoary Hair of Men, proceeds from the ſame *Cauſe*. 'Tis therefore, probable, that the firſt Feathers of Birds will often prove of different Colours, according to the Nature of the Bird; whilſt the Skin is more porous: but that *when the Skin is more cloſe, the Feathers will come white.* This Experiment may ſerve, not only to produce Birds and Beaſts of ſtrange Colours; but alſo to diſcloſe the Nature of Colours; and ſhew which of them require a finer, and which a coarſer Strainer [g]. See the *Articles* COLOURS, and PERCOLATION.

A fundamental Obſervation with regard to Tranſmutation.

4. In *Tranſmutations*, or grand Alterations of Bodies, there always comes a Medium between the Matter as it is at firſt, and the reſulting Matter; which Medium, is a Body imperfectly mixed, and not durable; but tranſitory; as Miſt, Smoke, Vapour, Chyle, and the Rudiments of Animals: and the middle Action, which produces ſuch imperfect Bodies, is, by ſome of the Ancients, aptly called *Inquination*, or Inconcoction; being a kind of Putrefaction: for the Parts are in confuſion, till they ſettle one way or other [h].

Experiments relating to the Tranſmutation of Air into Water.

5. 'Tis reported, that Sailors having, every Night, hung Fleeces of Wooll on the Sides of their Ships at Sea, could ſqueeze freſh Water out of them, in the Morning. And, we have tried, that a Quantity of Wooll, tied looſe together, being let down into a deep Well, about three Fathom from the Water, for a Night, in the Winter, increaſed in weight about a Fifth part [i].

6. 'Tis reported, that in *Lydia*, near *Pergamus*, certain Workmen, in the time of War, taking refuge in Caves, which being ſtopped by the Enemy, the Men were ſtarved; but, that the dead Bones were, long after, found, and ſome Veſſels which they had carried with them; the Veſſels being now full of Water, that was thicker, and nearer approaching to Ice than common Water:

[g] We have here an Inſtance of an Attempt to raiſe a *Work* upon the *Cauſe* derived, or endeavoured to be derived, under the *Article* PERCOLATION, § 7. If this *Cauſe* were verified, or found to be certainly true; it would become an *Axiom*: and the Work here intimated would then certainly prove ſucceſsful, for the End purpoſed. How far it may ſucceed, has not perhaps been properly tried. At leaſt, we may hence learn the Scope and Nature of this whole Piece of the *Sylva Sylvarum*; which is to diſcover *Cauſes*, and form them into pregnant *Axioms*, that readily direct to *Works*. And certainly, whoever ſhall underſtand, and properly practiſe this Method, may produce, not only ſtrange, but highly uſeful and ſerviceable Effects. The great Inconvenience is, that Perſons well verſed in this Way, might, in ignorant Ages, or ignorant Countries, be taken for Magicians: of which groſs and fatal Miſtake there are but too many Inſtances.

[h] We have here a *large Obſervation* of very general Extent, the capital Inſtances whereof deſerve to be collected, in order to raiſe it into an *Axiom*, or *Rule* of Practice. For, thus to operate by *Tranſmutation*, it ſhould ſeem that the Subject ought to be ſoftened, rarified, or ſubtilized; that being a Form the moſt ſuſceptible of Change. The Doctrine of the Adepts may deſerve to be conſidered upon this Occaſion.

[i] *Inſtances* of this kind can only be conſidered as *Inſtances of Approach*, with regard to the preſent Subject of *Tranſmutation*; being, perhaps, no more at bottom than Methods of collecting the inviſible aqueous Particles that float in the Air, (eſpecially near Water) and rendering them ſenſible: which is far from a *Tranſmutation*. See the *Articles* ALTERATIONS, CONCOCTION, GOLD, and PUTREFACTION.

Water: which is a remarkable *Inſtance of Condenſation by long burial* [k]; and of *Tranſmutation*, as it ſhould ſeem, of Air into Water; provided any of the Veſſels were at firſt empty. Try, therefore, ſmall Bladders of Air, immerſed in Snow, in Nitre, and in Quickſilver: and if you find the Bladder ſhrunk, the Air will appear condenſed by the cold of thoſe Bodies; as it would be in a Cave [l].

7. It is credibly reported, that in the *Eaſt-Indies*, if a Tub of Water be ſet open in a Room where Cloves are kept, it will be drawn dry in twenty-four Hours; tho it ſtand at ſome diſtance from the Cloves. And often, when Wooll is new ſhorn, our Country People fraudulently ſet ſome Pails of Water in the ſame Room, to increaſe the weight of the Wooll. But, perhaps, the heat remaining in the Wooll from the Body of the Sheep, or gathered by the cloſe lying, helps to draw the watry Vapour.

8. 'Tis alſo credibly reported, that Wooll new ſhorn, being caſually laid upon a Veſſel of Verjuice, had, after ſome time, drunk up great part of the Liquor; tho the Veſſel were without Flaw, and remained cloſe. So that there was a Percolation of the Verjuice thro' the Wood, in a kind of Vapour.

9. What facilitates the converſion of Air into Water, when the Air is not groſs, but ſubtilly mixed with tangible Bodies; is, that tangible Bodies have an Antipathy to Air: and if they find any Liquid more denſe near them, they will attract it, condenſe it more, and, in effect, incorporate it. Thus a Spunge, Wooll, or Sugar, being in part put into Water, or Wine, attract the Liquor higher than the Surface reaches. So Wood, Lute-Strings, *&c.* will ſwell in moiſt Seaſons; as appears by the breaking of the Strings, the hard turning of the Pegs, *&c.* which is a kind of Infuſion much like Infuſion in Water; that makes Wood ſwell: as in cloſing the Cracks of Bowls, by laying them in Water.

10. There appears alſo to be a converſion of Air into Water, in the ſweating of Marble and Wainſcot, in moiſt Weather. Which proceeds either from ſome Moiſture the Body yields; or becauſe the moiſt Air is condenſed againſt the hard Body. But it ſeems plainly the latter; for Wood painted with Oil-colours, will ſooner gather Drops in a moiſt Night, than Wood alone; becauſe of the ſmoothneſs and cloſeneſs, which admits no part of the Vapour; and therefore turns back, and condenſes it into Dew: as breathing upon a Glaſs, or other poliſhed Body, makes a Dew. So likewiſe, in froſty Mornings, we find Drops of Dew on the inſide of Glaſs-windows: and the Froſt itſelf upon the Ground, is but a Condenſation of the moiſt Vapours of the Night. Dew alſo, and Rains, are only the Returns of moiſt Vapours condenſed: the Dew being condenſed by the Cold from the Sun's Departure; and Rains, by the Cold of the middle Region of the Air.

11. 'Tis

[k] See the *Article* BURIALS.

[l] Neither the utmoſt force of *Cold*, nor of the *Condenſor*, ſeem to have been tried for this Purpoſe. See the *Chapter of Fire* in *Boerhaave's Chemiſtry*; where a Method is ſhewn of procuring an extreme degree of artificial Cold, by means of Ice and Spirit of Nitre.

11. 'Tis probable, that what will turn Water into Ice, may likewiſe turn Air, in ſome degree, to Water. Therefore try the common Experiment of turning Water into Ice, by Art[1]; uſing Air inſtead of Water. And tho it be a greater Alteration to turn Air into Water, than Water into Ice; yet there are hopes, that by continuing the Air longer, the Effect will follow: for the artificial converſion of Water into Ice, is the Work but of a ſhort time; whereas this may be tried for a Month, or more.

The ſeveral Ways for converting Air into Water.

12. There ſeem to be theſe probable Ways of converting *Vapour*, or *Air*, into Water and Moiſture. The *firſt* is by *Cold*; which manifeſtly condenſes, as we ſee by the contraction of the Air in the Weather-glaſs: whence Air by Condenſation appears to come a degree nearer to Water. We ſee it alſo in the Origin of Springs; which the Ancients thought owing to the converſion of Air into Water, promoted by the coldneſs of the Rocks; where Springs are chiefly generated. We ſee it alſo in the Effects of the Cold of the middle Region of the Air; which produces Dews and Rains. And the Experiment of turning Water into Ice, by means of Snow and Salt, ſhould be tried, as we before obſerved, for turning Air into Water. The *ſecond Way*, is by *Compreſſion*; as in Stills, where the Vapour is turned back upon itſelf, by the Sides of the Still: and again, in the Dew viſible upon Marble and Wainſcot, towards damp Weather. But this is likely to have no great Effect, except upon Vapour and groſs Air, already approaching near to Water. The *third* is, by *mixing* moiſt Vapours with Air, and trying if they will not produce a greater return of Water; for if ſo, that Increaſe is a converſion of the Air. Therefore put a certain weight of Water into a cloſe Still, and hang a large Spunge above the Water, to try what Quantity of Water may, after heating, be ſqueezed out of it, in proportion to the Water ſpent; for, if any Converſion can be wrought, it will be eaſieſt effected in the ſmall Pores of Bodies; which is the reaſon we preſcribe a Spunge. The *fourth Way* is, by receiving the Air into the ſmall Pores of Bodies; every thing in ſmall Quantity being, as we have before obſerved, more diſpoſed for Converſion; and all tangible Bodies endeavouring to condenſe Air: but in entire Bodies this Operation is checked; becauſe, if the Air ſhould condenſe, there is nothing to ſucceed. It muſt therefore be tried in looſe Bodies, as Sand and Powder; which, if they lie cloſe, do of themſelves gather Moiſture[m].

[1] *Viz.* Snow, or beaten Ice, and Salt, or other *artificial Mixtures*: among the ſtrongeſt whereof is reckoned *Sal Armoniac* diſſolved in Water; or, what is much ſtronger, Spirit of Salt, or Spirit of Nitre, poured upon *Ice* or *Snow*.

[m] The ſeveral Experiments here propoſed, may ſeem not to reach the Point; which indeed is a capital Work, if underſtood of an actual artificial Change of proper elaſtic Air into the groſs Body of Water. To underſtand the Author's Meaning, in this Particular, ſee the *Article* AIR; and for farther Light and Direction in the Affair, conſult the *Articles* ALTERATION, GOLD, PUTREFACTION, *&c.* There are alſo ſome uſeful Particulars relating to this Purpoſe, in the Author's *Hiſtory of Winds*; Sir *Iſaac Newton's Queries*, at the End of his *Opticks*; Mr. *Hales's Vegetable Staticks*; and Dr. *Boerhaave's Chemiſtry*, under the Chapters of *Air* and *Water*.

V.

A first Draught for the particular History of VEGETABLES *and* VEGETATION.

Introduction. 1. VEgetables should be diligently enquired into, as being a principal Part of the third Day's Work; the first *Producat*; and of excellent and general Use for Food, Medicine, and many Mechanic Arts [a].

2. HEADS of ENQUIRY.

ARTICLE I.

OF the Acceleration of Germination.

ARTICLE II.

Of the Retardation of Germination.

ARTICLE III.

Of the Melioration of Trees, Plants, and Fruits.

ARTICLE IV.

Of Compound Fruits and Flowers.

ARTICLE V.

Of the Sympathy and Antipathy of Plants.

ARTICLE VI.

Of rendering Fruits and Herbs medicinal.

ARTICLE VII.

Of Curiosities in Vegetation.

ARTI-

[a] The Author has here bestowed considerable Pains; and collected together a great number of Materials for the *physical History of Vegetation*. But what he delivers upon the Subject is not, perhaps, so valuable in itself, as for the Light and Direction it affords in executing the Design; by discovering *Causes*, and raising *Axioms*. With this View he recommends several Experiments to be tried, that are directly levelled at the Investigation of *Causes*: which Particular being usually unobserved by the common Writers upon *Agriculture* and *Horticulture*; they have often excepted to these *Experiments*, either as unsuccessful, or of little use; without penetrating into the Design of the Author, who chiefly writes for such Philosophers as can learn as much from an unsuccessful Experiment, as from one that shall succeed; and understand how to separate and concoct *Experience* into *Aphorisms*, *Axioms*, and sure *Rules* of future Practice: in which Light the *untried Experiments* here recommended, differ widely from those commonly practised by Gardeners; as having a much nobler View. And certainly they are unacquainted with the Nature and Use of the *Sylva Sylvarum*, who do not perceive the Excellence of the *untried Experiments* therein recommended, above those that have been usually tried.

ARTICLE VIII.
Of the Degeneration of Plants, and their Tranſmutation into one another.

ARTICLE IX.
Of the Tallneſs, Lowneſs, and Artificial Dwarfing of Trees.

ARTICLE X.
Of the Rudiments and Excreſcencies of Plants.

ARTICLE XI.
Of the Production of perfect Plants without Seed.

ARTICLE XII.
Of Exotic Plants.

ARTICLE XIII.
Of the Seaſons of Plants.

ARTICLE XIV.
Of the Duration of Herbs and Trees.

ARTICLE XV.
Of the different Figures of Plants.

ARTICLE XVI.
Of the principal Differences in Plants.

ARTICLE XVII.
Of Compoſts and Helps for Ground.

ARTICLE XVIII.
Of the Relation between Plants and inanimate Bodies.

ARTICLE XIX.
Of the Relation between Plants and Animals.

ARTICLE XX.
Miſcellaneous Experiments and Obſervations upon the Subject.

SECT. I.

Of the Acceleration of Germination.

Growth accelerated by Hot-beds.

3. (1.) WE ſowed, in a Hot-bed, *Turnip-ſeed*, *Radiſh-ſeed*, *Wheat*, *Cucumber-ſeed*, and *Peaſe*. The Bed was made of well-rotted Horſe-dung, laid upon a Bank half a Foot high, and ſupported round with Planks; and, upon the Top, we threw ſifted Earth, two Fingers deep. The Seed ſown upon it, was firſt ſteeped, all Night, in Water mixed with Cow-dung. The Turnip-ſeed and Wheat, came up half an Inch above Ground in two Days, without any watering; and the reſt came up the third Day. The Experiment was made in *October*: perhaps, in the Spring, the Acceleration might have been greater. Without this Help, the Seeds would have been four times as long in coming up. But there does not, at preſent, occur any profitable Uſe of this Experiment, unleſs for ſowing of Peaſe; the Price whereof is much increaſed by coming early. It may be tried alſo with Cherries, Strawberries, and other Fruits which are deareſt when early*.

The Effects of different Steepings.

4. (2.) We ſteeped *Wheat* in Water mixed with Cow-dung; in Water mixed with Horſe-dung; in Water mixed with Pigeon's-dung; in human Urine; in Water mixed with powdered Chalk; in Water mixed with Soot; in Water mixed with Aſhes; in Water mixed with Bay-ſalt; in Claret-wine; in Malmſey; and in Spirit of Wine. The Proportion of the Mixture was a fourth Part of the Ingredient to the Water; only of the Salt there was not above an eighth Part. The Urine, the Wines, and the Spirit of Wine, were without any Mixture of Water. The Time of the Steeping was twelve Hours; the Time of the Year, *October*. Along with theſe was alſo ſown another Parcel of unſteeped Wheat; but watered twice a-day with warm Water: and ſome we ſowed ſimple, to compare with the reſt. The Event was, that the Grain ſteeped in the Mixtures of Dung, Urine, Soot, Chalk, Aſhes, and Salt, came up within ſix Days: and thoſe that, afterwards proved the talleſt, thickeſt, and ſtrongeſt, were, firſt, the Urine; then the Dungs; next the Chalk; next the Soot; next the Aſhes; next the Salt; next the Wheat, unſteeped and unwatered; next that watered twice a-day with warm Water; and next the Claret-wine. So that the three laſt being ſlower than the ordinary Wheat of itſelf, this Culture proved rather prejudicial. As for thoſe that were ſteeped in Malmſey, and Spirit of Wine; they came not up at all†. This is a profitable Experiment,

* The common Hot-beds ſeem to require ſome conſiderable Improvements; to make them produce ſtrong and perfect, as well as quick and early. In order to improve them, enquire what is the moſt immediate or *material Principle* of Vegetation: or, if more Principles than one are concerned; let them all be duly regarded in the Preparation of *Artificial Compoſts*.

† See M. *Homberg's Experiments* upon Vegetation, in the *French Memoirs*.

ment; for moſt of the Steepings are cheap things: and the goodneſs of the Crop is a conſiderable point of Gain; if the goodneſs thereof anſwer the earlineſs of coming up; as probably it will; both proceeding from the Vigour of the Seed. The Experiment ſhould be tried in other Grain, Seeds, and Kernels; for, perhaps, certain Steepings agree beſt with certain Seeds. It ſhould alſo be tried with Roots, ſteeped for a long time: and in ſeveral Seaſons of the Year; eſpecially the Spring [q].

Watering with an Infuſion of Dung, recommended.

5. (3.) *Strawberries* being watered once in three Days, with Water wherein the Dung of Sheep, or Pigeons, has been infuſed, will come up early. And perhaps the ſame might hold in other Berries, Herbs, Flowers, Grains, or Trees. The Experiment therefore, tho common in Strawberries, is not yet brought into general Uſe. 'Tis a frequent Practice to help the Ground with Dung or Manure; but to water it with Muck-water [r], which ſeems more powerful, is not practiſed. Dung, Chalk, or Blood, ſeaſonably applied, in Subſtance, to the Roots of Trees, haſtens their Growth; but without ſome Mixture of Water, or Earth, perhaps ſuch Helps are too hot for Herbs [s].

Means of quickening the Spirit, and promoting the Nutrition of Vegetables.

6. The preceding Means of promoting Germination, depend upon the goodneſs and ſtrength of the Nouriſhment; or the ſupporting and exciting the Spirits in the Plant, the better to attract it: of the latter kind, are the Experiments following. (1.) To plant Trees againſt a Wall to the South, or South-eaſt Sun, haſtens their Growth and Ripening. The South-eaſt is found better than the South-weſt for this Purpoſe, tho the South-weſt be hotter; becauſe the heat of the Morning ſucceeds the cold of the Night; and partly, becauſe the South-weſt Sun is often too parching. (2.) So likewiſe the planting of them againſt a Chimney, where a Fire is kept, haſtens their coming up, and ripening: and drawing the Boughs into a Room where there is a conſtant Fire, produces the ſame Effect; as has been tried in Grapes; which will, thus, come a Month earlier than otherwiſe [t]. (3.) Another Means of accelerating Germination, is by making way for a ready Supply, and Attraction of the Nouriſhment; whence, gentle digging and looſening of the Earth about the Roots of Trees; and the removing of Herbs and Flowers into new Earth, once in two Years, (for the new Earth is always looſer) greatly promotes the thriving, and early coming of Plants. (4.) But the beſt Acceleration, in the Way of facilitating the Conveyance of the Nouriſhment, is that by Means of Water.

7. A

[q] The Farmers, in ſome Counties of *England*, now commonly ſteep their Seed-wheat in common Brine, or the Brine of their Pork-vats, to Advantage. But proper Trials of other uſeful Steepings are ſtill wanting; and ſhould be directed from ſome Knowledge of the *Material Cauſe of Vegetation*.

[r] That is by ſuffering the Dung to ſteep in the Water, whereby a Tincture of its more ſoluble Parts will be gained; and the more groſs Matter fall to the Bottom. Perhaps ſuch a Tincture may be too rich for certain Vegetables, or certain Beds; unleſs made dilute, or uſed but ſeldom.

[s] When uſed in too great plenty they prove prejudicial; otherwiſe they greatly invigorate Trees that are old or decayed.

[t] And yet prove excellent; as I have ſeen; particularly in *Holland*.

Roſes growing in Water.

7. A Standard of a Damaſk-roſe, with the Root on, being ſet upright in an earthen Pan, full of fair Water, half a Foot deep in the Water; the Top riſing more than two Foot above the Surface; and the Pan placed in a Chamber where no Fire was kept; within ten Days put forth a fair green Leaf; and ſome other little Buds, which made a Stand for above ſeven Days, without any Appearance of Decay or Withering. Afterwards the Leaf faded, but the young Buds ſprouted on, and opened into fair Leaves, in three Months time; and continued ſo a while after, till upon Removal we ceaſed the Trial. But the Leaves were ſomewhat paler, and lighter coloured, than others of the ſame Kind. The firſt Buds appeared at the end of *October*; and, 'tis probable, if it had been Spring-time, the Standard would have ſhot with greater ſtrength, and have grown on, to bear Flowers. By this means Roſes might be ſet in the midſt of a Pond; being ſupported by ſome Prop: which is matter of Pleaſure, tho of ſmall Uſe. The Experiment is the more ſtrange, becauſe a like Roſe-ſtandard being, at the ſame time, put into Water mixed with a fourth part of Horſe-dung, yielded no Leaves; tho ſeveral Buds at the firſt, as the other did [v].

Vegetables growing in Water only.

8. A *Dutch Flower*, with a bulbous Root, being, at the ſame time, placed wholly under Water, two or three Inches deep, ſprouted in ſeven Days; and continued growing long after. A Beet-root, a Borrage-root, and a Radiſh-root, all their Leaves being cut almoſt cloſe, were treated in the ſame manner; and had fair Leaves within ſix Weeks: and ſo continued till the end of *November* [u].

A double Advantage in accelerating Roots, &c.

9. If Roots, Peaſe, or Flowers, may be accelerated in their Growth and Ripening, a double Profit will attend it; becauſe of the advanced Price they bear when they come early; and again, becauſe of the Quickneſs of their return: thus, in ſome Grounds which are ſtrong, Radiſhes, for inſtance, will come in a Month; that, in other Grounds, would not come in two: and ſo make double Returns.

Wheat not growing in Water.

10. Wheat being put into Water, ſprung not at all; whence, probably, there is required ſome Strength and Bulk in the Body put into Water, as in Roots: for Grain, or Seeds, will mortify by the Cold of the Water. But a little lying caſually under the Pan, and being ſomewhat moiſtened by the Exudation thereof, tho it appeared mouldy, it was, in ſix Weeks, ſprouted half a Finger.

The Doctrine of the preceding Experiments.

11. It ſhould ſeem, by theſe *Inſtances*, that in point of Nouriſhment, Water is a capital Thing; and, that the Earth does but keep the Plant upright; and preſerve it from too much Heat or Cold [w]: which is comfortable Doctrine for great Drinkers. It proves alſo, that Drinks incorporated with Fleſh, or Roots, will nouriſh more eaſily than Meat and Drink, taken ſeparate [x].

12.

[v] No Concluſion can be ſafely drawn from this Experiment, for want of knowing whether there were no Difference in the Roots of the two Standards, or other Circumſtance.

[u] For the Reaſon why Water alone may nouriſh Plants, ſee Dr. *Woodward's Experiments* upon Vegetation, in the *Philoſophical Tranſactions*. Numb. 253.

[w] A farther Scrutiny, and more particular Experiments, ſeem requiſite, before any *Axiom* can be formed upon this Head. See the Chapter of *Water* in *Boerhaave's Chemiſtry*.

[x] See the *Article* FOODS.

12. (5.) The *Houſing of Plants* may contribute both to the Acceleration and Production of Flowers and Plants, in the colder Seaſons: and as we houſe the Exoticks of hot Countries; *viz.* Lemmons, Oranges, and Myrtles, to preſerve them; ſo we may houſe our Natives, to forward them, and make them thrive in the cold Seaſons. And thus we may have Violets, Strawberries, and Peaſe all Winter; provided they be ſown, or removed, at proper Times [y]. This Experiment is referable to the cheriſhing of the Spirit of the Plant by warmth, as well as houſing their Shoots, *&c.* So that the Means of accelerating Germination, are, in particular, eight [z]; and, in general three [a]. *The Advantages of houſing Plants.*

SECT. II.

Of the Retardation of Germination.

1. TO make Roſes, or other Flowers, come late, is an Experiment of Pleaſure. The Ancients highly eſteemed the *Roſa Sera:* and indeed the *November* Roſe is the ſweeteſt; as having been leſs exhaled by the Sun. The *Means are theſe*; *viz.* (1.) To cut off their Tops, immediately after they have done bearing; whence they will come again the ſame Year about *November*. They will not come juſt on the cut Tops; but upon thoſe Shoots, which were a kind of Water Boughs: becauſe the Sap, that would otherwiſe have fed the Top, will now divert to the Side-ſhoots; and make them bear, tho later. (2.) To pluck off the Buds when newly knotted; for then the Side-branches will bear: cutting off the Tops, and plucking off the Buds, having the ſame Effect, as to Retention of the Sap for a time; and the diverting it to the Roots, that were not ſo forward. (3.) To cut off ſome few of the top Boughs in the Spring, and ſuffering the lower to continue growing on; for the Shoots help to draw up the Sap more ſtrongly; as in the polling of Trees, 'tis uſual to leave a Bough or two on the Top, to draw up the Sap. And *'tis reported*, that by Grafting upon the Bough of a Tree, and cutting off ſome of the old Boughs, the new Cions will periſh [b]. (4.) To lay the Roots bare for ſome few Days about *Chriſtmas:* which ſtops the aſcent of the Sap for a time; tho it is afterward ſet free, by covering the Root again with Earth; whence the Sap mounts the later [c]. (5.) To remove the Tree a Month before it buds: for ſome time is required after the Removal, to reſettle it, before it can attract the Juice; and that time being loſt, the Bloſſom muſt needs come later. (6.) To graft Roſes in *May*, which Gardeners ſeldom do till *July*; and then they bear not till the next Year: but grafted in *May*, they will bear late the ſame Year. (7.) To *The ſeveral Means of making Flowers come late.*

[y] Due regard muſt be had, that the hot and dry Air of the Green-houſe does not exhale their aqueous Parts too faſt; and that a proper Supply of Air and Water be given them.

[z] See above, § 6, *&c.*

[a] See above, § 3, 4, 5, 6.

[b] This appears contrary to common Experience.

[c] But does this cauſe the Trees to bud or bear later afterwards?

(7.) To gird the Body of the Tree with Pack-thread; for this alſo, in ſome degree, reſtrains the Sap, and makes it aſcend later and flower [d]. (8.) To plant them in a Shade, or a Hedge; for thus they are retarded, partly by want of Sun, and partly by want of Nouriſhment, on account of the Hedges [e]. Theſe Means may be practiſed, both upon Trees and Flowers *mutatis mutandis* [f].

SECT. III.

Of the Melioration of Trees, Plants, and Fruits.

The Advantages of laying Stones to the Roots of Trees.

1. 'TIS Matter of Experience, that a Heap of Flint, or Stone, laid about the Bottom of a wild Tree, as an Oak, Elm, Aſh, &c. makes it proſper twice as much as without it. The *Cauſe* is, that it retains the Moiſture at any time falling upon the Tree; ſuffers it not to exhale by the Sun; and alſo defends the Tree from cold Blaſts, and Froſts, as it were in a Houſe [g]. Perhaps too there is ſomewhat in keeping it ſteddy at firſt. Let it be tried, if laying Straw to ſome height about the Body of the Tree, will not make it come forwards. For tho the Root affords the Sap, 'tis the Body that muſt attract it. But if Stones be laid about the Stalks of Lettuce, or other Plants that are ſoft, the Roots will be over-moiſtened, ſo that the Worms will eat them.

How Trees are to be ſtirred and cut, to make them thrive.

2. A Tree, at the firſt ſetting, ſhould not be ſhook till it has fully taken Root: whence ſome fix little Forks about the Bottom of their Trees, to keep them upright [h]; but, after a Year's rooting, ſhaking does the Tree good, by looſening the Earth, and perhaps by exerciſing, as it were, and ſtirring the Sap. Generally, the cutting away of Boughs, and Suckers, at the Root and Body, makes the Tree grow tall; as the polling and cutting off the Top, makes them ſpread and grow buſhy.

To haſten Coppice-wood.

3. *'Tis reported*, that to haſten Coppice-woods the Way is, to take Willow, Sallow, Poplar, or Alder, of ſeven Years growth; and ſet them a-ſlope, a reaſonable Depth under ground: when, inſtead of one Root, they will ſtrike many; and ſo carry more Shoots upon a Stem [i].

4. To

[d] Will not the Sap riſe in plenty, tho the Tree were ſtrongly girded?

[e] But will the Roſe-Trees thus planted bear at all; for want of the Sun, and proper Nouriſhment?

[f] How many of theſe probable Means of procuring late Flowers will ſtand good, after the Method of Rejection is practiſed upon them? Let it conſtantly be obſerved, that Experiments well directed, afford as much Light when they fail, as when they ſucceed. But it muſt be the Philoſopher, not the Gardener, who reaps this Fruit.

[g] One of the greateſt Inconveniences of this Practice is affording a harbour to Vermin; which might thus prove deſtructive to young Trees.

[h] Gardeners generally faſten their new planted Trees to a Stake with a Hay-band, to prevent their being rocked by the Wind; and continue them thus bound for ſome Years, if they deſire them to grow ſtrait.

[i] Is this verified by Experience?

4. To have many new Roots of Fruit-trees; bend a low Tree, lay all its Branches flat upon the Ground; caſt Earth upon them; and every Twig will take Root[k]. This is a very profitable Experiment in coſtly Trees; for thus Boughs will make Stocks without Charge. Try it in Apricots, Peaches, Almonds, Cornelians, Mulberries, Figs, *&c.* The like is conſtantly practiſed with Vines, Roſes, Muſk-roſes, *&c.* *To multiply Roots in Fruit-Trees.*

5. From *May* to *July*, peel off the Bark of any Bough, for three or four Inches; cover the bare place, ſomewhat above and below, with Loam, well tempered with Horſe-dung; binding it faſt down; then cut off the Bough about *Allhallon-tide*, in the bare place; ſet it, and 'twill grow to be a fair Tree. The *Cauſe* may be, that ſtripping off the Bark keeps the Sap from deſcending, towards Winter; and ſo continues it in the Bough. Perhaps alſo, the Loam and Horſe-dung applied to the bare place, moiſten, cheriſh, and make it more apt to put forth the Root. And this may prove a general Means to keep up the Sap of Trees in their Boughs, for other Purpoſes[l]. *To convert Boughs into Trees.*

6. It has been practiſed in Trees that ſhew fair, yet do not bear, to bore a Hole thro' the Heart of them, to render them fruitful: in which caſe, the Tree before might be too replete, and oppreſſed with its own Sap; for Repletion is an Enemy to Generation. It has alſo been practiſed in barren Trees, to cleave two or three of the chief Roots, and put a ſmall Pebble into the Cleft, to keep it open; which makes the Tree bear: for the Root, as well as the Body of a Tree, may be Bark-bound, and not keep open, unleſs ſomewhat be put into it[m]. *To render barren Trees fruitful, by opening the Body and Root.*

7. 'Tis uſual to ſet Trees that require much Sun, upon South Walls; as Apricots, Peaches, Plumbs, Vines, Figs, and the like. This has a double Convenience; *viz.* the heat of the Wall by Reflexion; and the preventing the Shade: for when a Tree grows round, the higher Boughs over-ſhadow the lower; but when ſpread upon a Wall, the Sun comes alike, both upon the upper and lower Branches[n]. *To meliorate Fruits by South Walls.*

8. It has alſo been practiſed, to ſtrip off ſome Leaves from the Trees ſo ſpread, that the Sun may come the better upon the Boughs and Fruit[o]. A Tree has likewiſe been ſet upon the North-ſide of a Wall to a ſmall height, then drawn thro' the Wall, and ſpread upon the South-ſide: that the Root and lower part of the Stock might enjoy the freſhneſs of the Shade; and the upper Boughs and Fruit the benefit of the Sun. But it ſucceeded not; becauſe the Root requires ſome cheriſhing from the Sun, tho under the Earth, *The Root of a Tree placed on a North, and the Boughs on a South Wall.*

[k] Is this Treatment ſucceſsful in Trees of all kinds, or only in ſome?

[l] The deſcending of the Sap in Trees, has been peremptorily denied by Gardeners: but for a full Account of this Matter conſult the *Philoſophical Tranſactions*; *French Memoirs*; and Mr. *Hales's Vegetable Staticks.*

[m] Theſe Experiments are, in ſome Caſes, found to anſwer the End propoſed: but they ſeem no general Methods of rendering barren Trees fruitful; each requiring a ſuitable Remedy according to the particular *Cauſe* of its Barrenneſs.

[n] This Method of Planting againſt a South Wall, is now extended to various Fruit-trees; and found eminently ſerviceable.

[o] This ſtripping off the *Leaves* of Fruit-Trees, is obſerved to haſten the ripening; but to ſtint the growth of the Fruit: for too much Sun puts a Period to Growth; or ripens before the time.

as well as the Body; and the lower part of the Body more than the upper, as we find in compaſſing a Tree below with Straw.

The Advantage of low Trees.

9. The lowneſs of the Fruit-boughs makes the Fruit greater, and cauſes it to ripen better [q]; for we always ſee in Apricots, Peaches, or Melo-cotones upon a Wall, the largeſt Fruit is towards the bottom. And in *France*, the Grapes that make the Wine, grow upon low Vines, bound to ſmall Stakes; whilſt the rais'd Vines, in Arbors, only make Verjuice [r]. 'Tis true, in *Italy*, and other Countries, where the Sun is hotter, they raiſe them upon Elms and Trees; but I conceive, that if the *French* manner of planting low, were practiſed there, the Wines would be ſtronger and ſweeter: But 'tis more chargeable on account of the Supporters. It were proper to try, whether a Tree grafted ſomewhat near the Ground, with the lower Boughs only maintain'd, and the higher continually pruned off, would not make a larger Fruit [s].

To produce plenty of Fruit.

10. To have plenty of Fruit, the way is, to graft, not only upon young Stocks, but upon ſeveral Boughs of an old Tree; for theſe will bear much Fruit: whereas, if you graft but upon one Stock, the Tree can bear but little [t].

Digging about the Roots of Trees recommended.

11. To dig yearly about the Roots of Trees, as a means both to accelerate and meliorate Fruits, is only practiſed in Vines; but if transferr'd to other Trees and Shrubs, I conceive it would improve them likewiſe. A Fruit-Tree being blown up, almoſt, by the Roots, and ſet again; it bore exceedingly the next Year. This ſeems owing to the looſening of the Earth, which refreſhes any Tree; and ſhould be practiſed more than at preſent in Fruit-Trees: for Trees cannot be ſo commodiouſly removed into new Ground, as Flowers and Herbs [u].

To revive old Trees.

12. To revive an old Tree, dig about its Roots, and apply new Mould thereto. We ſee that Draught-Oxen put into freſh Paſture, get new and tender Fleſh: and in all Caſes, better Nouriſhment than ordinary helps to renew; eſpecially if it be not only better, but differing from the former [v].

To make large Roots.

13. If an Herb be cut off from its Roots in the beginning of Winter, and the Earth be trod and beat down hard with the Foot and Spade, the Roots will be very large in Summer: for the Moiſture being thus kept from riſing

[q] On Account, perhaps, of the Heat reflected from the Earth; which reaches the lower Boughs ſtrongeſt.

[r] But is not this Difference chiefly owing to the Nature of the two ſeveral Species?

[s] This is found to anſwer, when the Branches of a Tree are bent downwards, and thrown along a South Wall.

[t] This is alſo a Method of producing Fruit quick, as in the firſt or ſecond Year; if the Grafts be from good Bearers. And hence we have an excellent way of converting old Trees to Profit; by letting them ſtand, inſtead of cutting them down for Fewel, and planting new, which will be long before they attain their Growth.

[u] This Expedient of digging about the Roots of Trees, is chiefly practiſed in ſtiff and cold Ground, and after the Trees have ſtood for ſome Years; leſt it might otherwiſe ſubject them to be blown down by the Winds.

[v] The Soil may ſometimes be too rich of itſelf; and then the addition of a poorer Kind is an Amendment.

riſing in the Plant, ſtays longer in the Root, and ſo dilates it. And Gardeners commonly tread looſe Ground, after ſowing Onions, Turnips, *&c.* *Panicum* laid below and about the bottom of a Root, will cauſe it to grow exceſſively; for being itſelf of a ſpungy Subſtance, it attracts the moiſture of the Earth, and ſo feeds the Root. This is of principal Uſe for Onions, Turnips, Parſnips, and Carrots.

14. The ſhifting of Ground is a means to meliorate Trees and Fruits; but with this Caution, that all Things proſper beſt when advanced from worſe to better [v]. Thus Nurſeries of Stocks ſhould be in a more barren Ground, than that whereto they are removed: and all Graſiers remove their Cattle from poorer Paſture to richer. So hardineſs in Youth prolongs Life; becauſe it leaves the Body improvable in Age: and even in Exerciſes, 'tis good to begin with the hardeſt, as dancing in thick Shoes, *&c.* *Melioration by Shifting.*

15. Hacking of Trees in their Bark, both right down and acroſs, ſo as to make rather Slits than continued hacks, is highly ſerviceable to Trees; prevents their being Bark-bound, and kills the Moſs [x]. *Slitting the Bark of Trees.*

16. Shade conduces to render ſome Plants large and proſperous, more than the Sun; as in Straw-berries, Bays, *&c.* And therefore to ſow Borage-ſeed thin among Straw-berries, will make the Fruit under the Borage-leaves far larger than their Fellows [y]. And Bays ſhould be planted to the North, or defended from the Sun, by a Hedge-row: and when you ſow the Berries, weed not the Borders for the firſt half Year; becauſe the Weeds afford a proper Shade. *Shade uſeful to ſome Plants.*

17. To increaſe the Crops of Vegetables, we muſt not only increaſe the Vigour of the Earth, and of the Plant; but alſo preſerve what would otherwiſe be loſt. Thus the late Trial to ſet Wheat, is now left off, becauſe of the Trouble and Pains it required: yet there is much ſaved by *Setting*, in Compariſon of *Sowing*; as keeping the Seed from being eat up by the Birds, and avoiding the ſhallow lying of it, whereby much of what is ſown, cannot take Root. *Conſiderations for augmenting the Crops of Vegetables.*

18. *'Tis reported*, that if Nitre be mixed with Water, to the thickneſs of Honey, and after a Vine is cut, the Bud be anointed therewith, it will ſprout within eight Days. If the Experiment be true; the *Cauſe* may lie in the opening of the Bud, and contiguous Parts, by the Spirit of the Nitre; for Nitre is the Life of Vegetables [z]. *Nitre the Principle of Vegetation.*

[v] This Caution admits of an Exception, where the Soil was too rich; in which Caſe removing to a poorer, would render the Tree more healthy and fruitful. Many of the *Rules of Medicine* ſeem to have place in Vegetables.

[x] This is chiefly practiſed in Trees of ſome years Growth; and found very uſeful, eſpecially when they are already Bark-bound.

[y] But then the Shade muſt not be large. Perhaps Straw-berries are beſt delighted with a mixture of Sun and Shade.

[z] How far this may be true, is not perhaps ſufficiently ſhewn; notwithſtanding the Experiments of Sir *Kenelm Digby*, and M. *Homberg*. Conſult Mr. *Evelyn's Sylva*; the *Philoſophical Tranſactions*; the *French Memoirs*; and Dr. *Stahl's Philoſophical Principles of Chemiſtry*: but a proper Set of accurate Experiments ſeem ſtill wanting in this View.

Seeds ſown in a Sea-Onion.

19. Put any Seed, or the Kernels of Apples, Pears, Oranges, the Stone of a Peach, a Plumb, *&c.* into a Squill; and they will come up much earlier than when ſown in the Earth itſelf. This I conceive is a kind of grafting in the Root; for as the Stock yields a better prepared Nouriſhment to the Graft than the crude Earth; ſo does the Squill to the Seed. And I ſuppoſe the ſame would ſucceed, by putting Kernels into a Turnip, or the like; only that the Squill is more vigorous and hot. It may be tried alſo, by putting Onion-ſeed into an Onion; which thereby, perhaps, will bring forth larger and earlier [a].

Fruits ſeem ripen'd by pricking.

20. Tho pricking of Fruit in ſeveral places, when almoſt full grown, and before it ripens, has been practis'd with Succeſs, to bring it ſooner to Maturity. The biting of Waſps or Worms upon Fruit, cauſes it to ripen manifeſtly quicker. *'Tis reported*, that Sea-weed, put under the Roots of Coleworts, and other Plants, will forward their Growth. The Virtue, no doubt, has relation to Salt, which greatly promotes Fertility [b].

To bring Cucumbers early.

21. It has been practiſed to cut off the Stalks of Cucumbers, immediately after their bearing, cloſe by the Earth; and then to throw a quantity of Mould upon the remaining Plant: which makes them bear fruit the enſuing Year, long before the ordinary time. The *Cauſe* may be, that the Sap goes down the ſooner, and is not ſpent in the Stalk or Leaf, remaining after the Fruit. The dying of the Roots of annual Plants in the Winter, ſeems partly owing to the profuſion of Sap in forming the Stalk and Leaves; which being prevented, they will ſuper-annuate, if they ſtand warm.

The Uſe of pluck ing off ſome Bloſſoms from Trees.

22. To pluck off many of the Bloſſoms from a Fruit-Tree, makes the Fruit fairer: the Sap thus having leſs to nouriſh. And 'tis commonly obſerved, that if ſome Bloſſoms be not plucked off the firſt time a Tree blows, it will bloſſom itſelf to death [c].

A Trial of plucking off all the Bloſſoms recommended.

23. It were proper to try the Effect of plucking off all the Bloſſoms from a Fruit-Tree; or the Acorns, Cheſnut-Buds, *&c.* from a wild Tree; for two years together. I ſuppoſe the Tree would either yield Fruit the third Year, larger, and in greater plenty; or elſe, the larger Leaves, in the intermediate Years, becauſe of the Sap here treaſured up [d].

Whether Plants grow quicker when watred with warm Water.

24. It has been generally received, that a Plant watered with warm Water, will come up ſooner and better, than when water'd with cold Water, or Showers. But our Experiment of watering Wheat with warm Water did not ſucceed; perhaps becauſe made too late in the Year, *viz.* the end of *October*: for the Cold then coming upon the Seed, after being render'd more tender by warm Water, might check it.

25. No

[a] Theſe Experiments appear probable; but how they anſwer upon Trial, ſhould be particularly obſerved and recorded. They ſeem better fitted for the Uſe of Philoſophers than Gardeners; and therefore perhaps have not been fully proſecuted.

[b] See more to this purpoſe under the *Article* MATURATION.

[c] Eſpecially if the Tree be lately planted, and the Root be weak.

[d] Has this Experiment been duly made?

25. No doubt, but grafting generally meliorates the Fruit; becauſe the Nouriſhment is better prepared in the Stock, than in the crude Earth [e]. Yet ſome Trees are ſaid to come up ſtronger from the Kernel, than from the Graft; as the Peach and Melo-cotone: perhaps becauſe thoſe Plants require a Nouriſhment of greater Moiſture. And tho the Nouriſhment of the Stock be finer and better prepared; yet 'tis not ſo moiſt and plentiful as that of the Earth: and indeed we find thoſe Fruits very cold in their Nature. *The Melioration of Fruit by Grafting.*

26. It has been received, that a ſmaller Pear, grafted upon a Stock bearing a larger Pear, will become large: but I judge that the Cions will govern. Yet, probably, if you can get a Cion to grow upon a Stock of another kind, that is much moiſter than its own, it may make the Fruit larger; becauſe it will yield more Nouriſhment; tho perhaps coarſer. But Grafting is generally practiſed upon a drier Stock; as the Apple upon a Crab; the Pear upon a Thorn, *&c.* Yet 'tis reported, that, in the *Low-Countries*, they will graft an Apple-Cion on a Colewort-Stock, and it ſhall bear a great flaggy Apple; the Kernel whereof if ſet, will prove a Colewort, not an Apple. It were proper to try whether an Apple Cion will proſper, when grafted upon a Sallow, a Poplar, an Elder, an Elm, or a Horſe-Plumb; which are the moiſteſt of Trees. I have heard it has been tried with Succeſs upon an Elm [f].

27. Tis manifeſt by Experience, that Flowers removed, grow larger; becauſe Nouriſhment is more obtained in looſe Earth. Perhaps alſo, frequently to regraft the ſame Cions, may make the Fruit larger; as if a Cion were grafted upon a Stock the firſt Year; then cut off and grafted upon another Stock the ſecond Year; and ſo the third or fourth; at laſt permitting it to reſt; to try if when it bears, it will yield a larger Fruit [g]. *Tranſplantation and Regrafting.*

28. If a Fig-tree produce better Figs, for having its Top cut off when its Leaves begin to ſprout, the *Cauſe is* plain; the Sap now having fewer Parts to feed, and a leſs way to mount: but perhaps the Figs will come ſomewhat later. The ſame may alſo be tried in other Trees [h]. *Melioration of Figs, by cutting off the top of the Tree.*

29. 'Tis reported, that Mulberries will be fairer, and the Trees more fruitful, if you bore their Trunks thro' in ſeveral places, and force into the Apertures, wedges of ſome hotter Tree; as Turpentine, Maſtich, Guaiacum, Juniper, *&c.* perhaps becauſe the adventitious Heat revives the native Juice of the Tree. 'Tis alſo reported, that Trees will grow larger, and bear better *Melioration of cold Fruit, by Wedges of hot Trees; and rich Compoſts.*

[e] Is this Reaſon juſt? Do not the Branches of an ungrafted Tree, receive their Nouriſhment from the Stock, as well as the Graft does? Or does not the Advantage of Grafting depend upon the Nature of the Graft, and its being choſe from a better Tree than that whereon it is grafted?

[f] The Buſineſs of Grafting and Inoculation require a ſtrict phyſical Enquiry; and a ſuitable variety of judicious and well calculated Experiments.

[g] This is ſaid to have been tried without Succeſs: the Grafts ſtill retaining their original Nature.

[h] If this be practiſed on young Trees; it makes them throw out large ſtrong Shoots, that are apt to continue for a Seaſon or two unfruitful.

better Fruit, by having Salt, Wine-Lees, or Blood applied to the Root; theſe Things being more forcible than ordinary Compoſts [i].

Melioration of Herbs by Potting, and watering with Salt-Water.

30. Herbs will become tenderer and fairer, if taken out of their Beds, when newly come up; and removed into Pots with better Earth. Coleworts are reported to proſper exceedingly, and to be better taſted, if ſometimes water'd with Water mix'd with Salt; or much rather with Nitre; the Spirit whereof is leſs heating [k].

Steeping Seeds in Milk.

31. 'Tis ſaid, that Cucumbers will prove more tender and excellent, if their Seeds be ſteeped a little in Milk: perhaps becauſe the Seed being mollified with the Milk, is too weak to attract the groſſer Juice of the Earth, and ſo takes only the finer. The ſame Experiment may be made with Artichoaks, and other Seeds, in order to take away either their Flaſhineſs or Bitterneſs.

To meliorate Cucumbers.

32. *'Tis reported*, that Cucumbers will be leſs watry, and more Melon-like, if the Pit where they grow be half fill'd with Chaff; or ſmall Sticks; and Earth be thrown upon them: for Cucumbers extremely affect Moiſture; and are apt to over-drink themſelves; which this Procedure prevents [l].

Melioration by Terebration and Tapping.

33. The Terebration of Trees not only makes them proſper, but alſo renders the Fruit ſweeter: for notwithſtanding the Perforation, they may receive ſufficient Nouriſhment; yet no more than they can well digeſt; and at the ſame time ſweat out the coarſeſt and unprofitable Juices, as in Animals; which by moderate Feeding, Exerciſe, and Sweat, attain the ſoundeſt Habit of Body. And as Terebration meliorates Fruit; for the like Reaſon does the Bleeding of Plants, as by pricking the Vine, or other Trees, after they are ſomewhat grown; and thus letting out their Gums or Tears: tho this be not to continue, as in Terebration; but to be done only at certain Seaſons [m]. And it is reported that by this means, Bitter Almonds have been turn'd into Sweet.

Melioration by Retardation of the Sap.

34. 'Tis obſerved, that all Herbs become ſweeter, both in Smell and Taſte, if, when grown up ſome ſeaſonable time, they be cut; and the later Sprout be choſe. The Reaſon may be, that the longer the Juice continues in the Root and Stalk, the better it is concocted. For one chief *Cauſe* why Grain, Seeds, and Fruits, are more nouriſhing than Leaves, is the length of Time they require to ripen. It were not amiſs to keep back the Sap of Herbs, by ſome proper means, till the end of Summer; whereby perhaps they will become more nouriſhing [n].

35. As

[i] Theſe Materials being extremely rich, are to be ſparingly uſed; and, perhaps, chiefly in the Winter.

[k] See M. *Homberg*'s Experiments upon Vegetation, in the *French Memoirs*.

[l] Does this Experiment ſucceed upon Trial?

[m] For the Method and Uſes of Tapping Trees, ſee certain Papers in the *Philoſophical Tranſactions*; particularly N° 43. 48. 57. 58. 68.

[n] This is an Experiment of Conſequence; and requires that the beſt means ſhould be thought of for trying it; whether by Cold, Ligature, want of Moiſture, or otherwiſe.

35. As grafting generally advances and meliorates Fruits above what they are when produced from Stones, Seeds or Kernels; becauſe the Nouriſhment is better concocted; ſo in Grafting itſelf, for the ſame Cauſe, the choice of the Stock contributes much; provided it be ſomewhat inferior to the Cion: otherwiſe it obſtructs. The grafting of Pears and Apples upon a Quince is highly commended [o]. *The Stock in Grafting to be poorer than the Cion.*

36. Beſides the abovementioned means for meliorating Fruits, it has been tried, that a mixture of Bran and Swine's-Dung, or Chaff and Swine's-Dung, laid to rot for a Month, greatly nouriſhes and ſupports Fruit-Trees [p]. *Melioration by Compoſts.*

37. *'Tis ſaid*, that Onions grow larger, if, being taken out of the Earth, they are laid to dry for twenty days, and then ſet again; and yet more, if the outermoſt Coat be taken off all over. *Melioration of Onions.*

38. *'Tis ſaid*, that if the Bough of a low Fruit-Tree newly budded, be gently drawn, without hurting it, into an earthen Pot, perforated at the bottom to receive it; and then the Pot be cover'd with Earth; it will yield a very large Fruit within the Ground. Which Experiment is no more than potting of Plants without removing; and leaving the Fruit in the Earth. The like, *they ſay*, may be effected by an empty Pot, without Earth in it, put over a Fruit, ſupported as it hangs upon the Tree; and the better if ſome few Holes be made in the Pot. In this Experiment, beſides defending the Fruit from the Extremity of the Sun or Weather, ſome aſſign for a Reaſon, that the Fruit coveting the open Air and Sun, is invited by thoſe Holes to ſpread and approach as near them as it can; and thus enlarges in Magnitude [q]. *Melioration by potting of Fruit.*

39. All Trees in high and ſandy Grounds are to be ſet deep; and in watry Grounds more ſhallow. And in the removal of Trees, eſpecially Fruit-Trees, care ſhould be taken that their Sides be ſet North and South, *&c.* as they ſtood before [r]. *Trees when tranſplanted to retain their former Poſition.*

40. Timber-Trees in a Coppice, grow better than in an open Field; becauſe they ſpread not ſo much, but ſhoot up in height; and chiefly becauſe they are defended from too much Sun and Wind, which check the Growth of all Fruit. And thus, no doubt, Fruit-Trees, or Vines, ſet againſt a Wall to the Sun, between Elbows or Buttreſſes of Stone, ripen the Fruit better than a plain Wall [s]. *Trees grow beſt againſt buttreſs'd Walls.*

41. 'Tis

[o] See above, § 25, 26.

[p] In the time of rotting, a conſiderable Heat is generated, which might prove unſuitable to certain Trees; but by the Operation, the whole is turn'd into an uniform kind of Mould. The *Hiſtory of Vegetation* requires a previous Enquiry into the *Nature, Office, and Uſe of Putrefaction.*

[q] Tho a large Fruit may be thus procured; yet will it be ſo well ripen'd, as another more expoſed to the Sun?

[r] Do Gardeners find any Neceſſity for obſerving this Rule? Or is any Advantage certainly found in obſerving it?

[s] On account of the Sun's Rays reflected upon the Fruit, and the general Heat thus thrown by the Stone-Elbows upon the Trees.

Potting of Roots.

41. 'Tis ſaid, that if Potato Roots be ſet in a Pot fill'd with Earth, and the Pot be ſet in the Ground two or three Inches deep, the Roots will grow larger than ordinary. The *Cauſe* may be, that having Earth enough within the Pot to nouriſh them; and being ſtopped by the bottom of the Pot from ſhooting their Strings downward; they grow more in Breadth and Thickneſs. And perhaps all Seeds or Roots potted, and ſo ſet in Earth, will proſper better.

Covering them high with Earth in Winter.

42. The cutting off the Leaves of Radiſh, or other Roots, in the beginning of Winter, before they wither, and covering again the Root ſomething high with Earth, will preſerve the Root all Winter; and make it larger the following Spring. So that there is a double uſe of this cutting: for in Plants, where the Root is eſculent, as Radiſh and Parſnip, it will make it greater: and ſo it will the heads of Onions [t]. And where the Fruit is eſculent, it will by ſtrengthning the Root make alſo the Fruit larger.

To procure Foliage to Trees, by Grafting.

43. 'Tis an Experiment of great pleaſure, to make the Leaves of ſhady Trees larger than ordinary. It has been tried, that a Cion of a Weech-Elm, grafted upon the Stock of an ordinary Elm, will put forth Leaves almoſt as broad as the brim of a Hat. And 'tis very likely, that as in Fruit-Trees the Graft makes a larger Fruit; ſo in Trees that bear no Fruit, it will make the Leaves larger. It ſhould therefore be tried in ſuch Trees as Birch, Aſp, Willow; and eſpecially the ſhining Willow call'd Swallow-Tail, for the Pleaſure of its Leaf [u].

The Cauſes of Barrenneſs in Trees.

44. The Barrenneſs of Trees by Accident, beſides the weakneſs of the Soil, Seed or Root, and the injury of the Weather, proceeds either, (1.) from their being overgrown with Moſs; (2.) Bark-bound; (3.) planted too deep; or, (4.) from the Sap going too much into the Leaves: For all which there are Remedies mention'd above [v].

SECT. IV.

Of Compound Fruits and Flowers.

The Production of new Species of Vegetables recommended.

1. IN Animals that have Male and Female, there are ſeveral kinds of Copulation, productive of compounded Creatures: thus the Mule is generated betwixt the Horſe and the Aſs, *&c.* The Compounding or Mixture of Kinds in Plants is not known; which, however, if poſſible, were a Thing more at Command than in living Creatures; where Generation requires

[t] 'Tis the common Practice to Plant Salary in Trenches, and cover it high with Earth, ſome time afterwards; in order to procure the greater Length of the white eſculent Root.

[u] The Graft being taken from ſuch Trees as afford the greateſt Foliage, and a proper Stock made Choice of.

[v] There may perhaps be many other Cauſes of Barrenneſs in Trees, beſides thoſe here enumerated; as Blaſts, Inſects, Cold, Wet, *&c.* all which require their particular Remedies.

quires a voluntary Motion. This would therefore be a capital Experiment in Vegetation, if diſcover'd: for thus we might have great variety of Fruits and Flowers hitherto unknown. Grafting does not produce this Effect; as only mending the Fruit, or doubling the Flowers, *&c.* without making any new Kind. For the Cion conſtantly over-rules the Stock [w].

Experiments for compounding of Fruits.

2. It is *anciently deliver'd*, that two Twigs of different Fruit-Trees, being flatted on the oppoſite Sides, then bound cloſe together, and ſet in the Ground, will come up in one Stock; yet put forth their ſeveral Fruits without commixture in the Fruit. Where note, that Unity of Continuance is eaſier to procure, than Unity of Species. It is reported alſo, that Vines of red and white Grapes, being ſet in the Ground, and the upper Parts being flatted and bound cloſe together, will yield Grapes of ſeveral Colours, within the ſame Grape; but the more after a Year or two: the Unity, as it ſeems, growing more perfect. And it will alſo contribute, if from the firſt uniting, they be often watred; *for all Moiſture promotes Union.* It is alſo preſcribed to bind the Bud as ſoon as it comes forth, as well as the Stock, at leaſt for a time [x].

3. *They report*, that different Seeds, wrapped in a Cloth, and laid in Earth well dunged, will riſe contiguous Plants; which being afterwards bound together, their Shoots will incorporate: and the like is *ſaid* of Kernels put into a Bottle with a narrow Mouth, and fill'd with Earth. So again, *they ſay*, that young Trees, of ſeveral Kinds, ſet contiguous, without any binding, and very often water'd in fruitful Ground, will, thro' the very Luxury of the Trees, incorporate, and grow together: which ſeems a more likely means; becauſe the binding hinders the natural ſwelling of the Trees, which, unite the better whilſt in Motion [y].

SECT. V.

Of the Sympathy, and Antipathy, of Plants.

The Sympathy and Antipathy of Plants explained of Attraction.

1. THERE are many received Traditions, about the Sympathy and Antipathy of Plants; ſome thriving beſt when they grow near others, which is imputed to Sympathy; and ſome worſe, which is imputed to

[w] Have the proper Experiments for this purpoſe been hitherto tried, with the *Farina Fœcundans* of Flowers, *&c?* See the *French Memoirs*, for the Year 1711, *&c.*

[x] Theſe Experiments ſeem to ſavour more of Imagination than Practice.

[y] Tho Experiments of this kind, ſo ſlightly recommended, either by Reaſon or Authority, may perhaps ſcarce deſerve to be tried; yet they have this Uſe, that they ſhew diſtreſs; and ſhould excite the Induſtry of Philoſophers to invent better for the Purpoſe. Let the Means of Generation in Plants be once exactly diſcover'd; and Experiments for compounding or mixing of their Species, will ariſe of themſelves. Let particular Enquiry be made into the Fact deliver'd in the *Philoſophical Tranſactions*, N° 29. pag. 553. of the Orange Trees at *Florence*, that bear a Fruit, half Citron, half Orange; and are propagated by Engrafting. The Relation ſeems in a particular manner confirm'd, illuſtrated and explained, N° 114. pag. 313. of the ſame Tranſactions.

to Antipathy. But theſe are idle and ignorant Conceits, that forſake the true *indication of Cauſes*; as moſt Experiments do concerning Sympathies and Antipathies [z]. Plants have no ſuch ſecret Friendſhip, or Hatred; and to call it Sympathy and Antipathy, is quite miſtaking the Thing; their Sympathy being an Antipathy, and their Antipathy a Sympathy: for when ever one Plant attracts ſuch a particular Juice from the Earth, as qualifies the remaining for another Plant, there Proximity does good; becauſe the Nouriſhment of the two Plants are contrary: and where two Plants draw the ſame Juice, there growing near together does hurt; becauſe the one thus defrauds the other.

Whence Plants become unfriendly to each other.

2. Firſt therefore, the Plants that attract much Nouriſhment from the Earth, and ſo exhauſt it, prejudice all Things that grow near them; thus great Trees, eſpecially Aſhes, and ſuch as ſpread their Roots near the Surface, are pernicious to other Plants [a]. So the Colewort is not an Enemy to the Vine only; but to any other Plant: becauſe it ſtrongly attracts the fatteſt Juice of the Earth [b]. And if it be true, that the Vine, when it creeps near the Colewort will turn aſide; this may happen, becauſe it there finds worſe Nouriſhment: for tho the Root be where it was, yet I ſuſpect the Plant will bend as it nouriſhes.

Whence friendly.

3. Where Plants are of different Natures, and attract different Juices, there the one being ſet by the other is of Service: as Rue proſpers and becomes ſtronger; if ſet by a Fig-tree: which may proceed from the Extraction of a contrary Juice: the one drawing Juice fit to become ſweet, the other bitter. So, *they ſay*, that a Roſe ſet by Garlick is ſweeter: which likewiſe may happen, becauſe the more fetid Juice of the Earth goes into the Garlick, and the more odorate into the Roſe [c].

Certain Flowers peculiar to Corn Fields.

4. 'Tis manifeſt, that certain Corn-flowers ſeldom or never grow in other places, unleſs they are ſet, but only among Corn: as the Blue-bottle, a kind of yellow Mary-gold, the wild Poppy, and Fumitory. Nor can this proceed from the Culture of the Ground, by plowing or furrowing; as ſome Herbs and Flowers will grow but in Ditches new caſt up; for if the Ground lie fallow and unſown, they will not come: whence it ſhould ſeem to be the Corn that qualifies the Earth, and prepares it for their Growth [d].

Trials recommended for meliorating the Taſtes and Odours of Vegetables.

5. If the foregoing Obſervation holds, it is of great Uſe for meliorating the taſte of Fruits, eſculent Herbs, and the ſcent of Flowers. For if the Fig-tree makes the Rue ſtronger and bitterer; Rue plentifully planted about the Fig-tree, may make the Fig ſweeter. And as the Taſtes that offend in Fruits,

[z] See the *Article* SYMPATHY.

[a] Eſpecially if beſides drawing away their Nouriſhment, they alſo over-ſhade ſuch Plants.

[b] Is there certainly found to be an Appetite of Election in Plants, whereby they attract one particular Juice of the Earth, and refuſe another? Or is there a ſufficient variety of Juices in the Earth to feed all the different Species of Vegetables in the ſame Garden, or Country? See below, § 3.

[c] Is there any Certainty in theſe Relations? Is the Suppoſition of different Juices in the Earth confirmed? Or do all Plants make their own Juices, reſpectively, from one or more common Juices of the Earth? See below, *Sect.* VI. 1.

[d] Are not the Seeds of theſe Flowers ſown along with the Corn?

Fruits, Herbs, and Roots, are bitter, harſh, ſour, and watriſh; it were proper to make the following Trials. (1.) Set Wormwood, or Rue, near Lettuce, Colliflower or Artichoke; to try whether theſe will become ſweeter. (2.) Take a Service-Tree, a Cornelian, or Alder, whoſe Fruits have a harſh and aſtringent Juice; and ſet them near a Vine, or Fig-tree; to find whether the Grapes or Figs will thus be the ſweeter. (3.) Set Cucumbers or Pompions among Musk-Melons; to ſee whether the Melons will not be more vinous; and better taſted. (4.) Set Cucumbers alſo among Radiſh; to try whether the Radiſh will be the more biting. (5.) Set Sorrel among Rasberries; to ſee whether the Rasberries will be the ſweeter. (6.) Set common Briar among Violets, or Wall-flowers; to ſee whether it will make the Violets or Wall-flowers ſweeter, and of a leſs earthy Odour. (7.) So ſet Lettuce, or Cucumbers, among Roſemary, or Bays; to try whether the Roſemary or Bays will become more aromatic. (8.) On the other hand, beware of ſetting ſuch Plants together, as draw nearly the ſame Juice. I ſuſpect Roſemary would loſe part of its ſweetneſs, if ſet with Lavender, Bays, or the like. (9.) Yet to correct the Strength of an Herb, others of like kind may be ſet near to lower it; thus Tanſy ſet by Angelica, may be made weaker, and fitter for Mixture in Perfumes: and Rue ſet by common Wormwood, might become liker to *Roman Wormwood* [e].

To correct poiſonous and purgative Plants by Juxtapoſition.

6. Trial ſhould alſo be made in poiſonous and purgative Herbs, whoſe ill qualities might perhaps, be diſcharged, or corrected, by ſetting ſtronger Poiſons, or Purgatives near them. 'Tis reported, that the Shrub call'd *Ladies-Seal*, (which is a kind of Briony) and Coleworts, if ſet near each other, one or both of them will dye; being, I ſuppoſe, depredators of the Earth, ſo that one of them ſtarves the other. The like is ſaid of the Reed and the Brake; both which are ſucculent: and therefore the one may defraud the other. Underſtand the like of Hemlock and Rue; both which attract ſtrong Juices [f].

The Sympathy betwixt Plants and the celeſtial Bodies.

7. Many who have laboured in *Natural Magick*, obſerve a Sympathy between the Sun, Moon, ſome principal Stars, and certain Plants; whence they have denominated ſome Herbs Solar, ſome Lunar; and delivered ſuch Trifles in lofty Language. 'Tis manifeſt, that ſome Flowers have two reſpects to the Sun; the one by opening and ſhutting; the other by bowing and inclining their Heads. For Marygolds, Tulips, Pimpernel, and moſt Flowers open their Leaves, when the Sun ſhines clear; and in ſome meaſure cloſe them, either towards Night, or when the Sky is overcaſt. Of this there needs no ſuch ſolemn Reaſon, as that ſuch Plants rejoice in the Preſence, and mourn in the Abſence of the Sun; the *Cauſe* being no more than

[e] Theſe Experiments being here only recommended upon the preceding Suppoſition, that Plants, according to their ſeveral Natures, attract different Juices from the Earth, have not, perhaps, been made with ſufficient Attention. The Advantages to be expected from the direct Experiments, are no ſufficient Recommendation of them to Gardeners; but they have a higher Uſe in aſſiſting to determine whether there are different kinds of Juices in the Earth.

[f] Perhaps the certain Fact in theſe Matters is not hitherto fully diſcover'd; for want of Sets of proper Trials, repeated with due Attention, and Accuracy.

than a little Moiſture of the Air, which loads the Leaves, and ſwells them at the bottom; whereas the dry Air expands them. And ſome make it a wonder, that Garden-Clover ſhould hide the Stalk when the Sun ſhines bright; tho this be nothing but a full Expanſion of the Leaves. The Plants that bow and incline the Head, are the great Sun-flower, Marygold, Wart-wort, Mallow-flowers, *&c.* The Cauſe of this is ſomewhat more obſcure than the former; but I take it to be no other than that the part againſt which the Sun beats, grows weaker and more flaccid in the Stalk; and thence becomes leſs able to ſupport the Flower [f].

The Effect of Moiſture upon Vegetables ſhewn by an Example.

8. What Effect a little Moiſture may have upon Vegetables, even tho dead, and ſevered from the Earth, appears in the Experiment of Jugglers; who take the Beard of an Oat, which is wreath'd at the bottom, and a ſmooth entire Straw a-top; chuſing only the wreathed part, and cutting off the other, ſo as to leave the Beard half an Inch long. Next they make a little Croſs of a Quill, lengthwiſe of that part of the Quill which has the Pith, and croſs-wiſe of that part which has none; the whole Croſs being half an Inch high. Then they prick a Hole in the bottom where the Pith is, and put the Oaten-beard therein; leaving half of it ſticking out of the Quill. Now they take a little white wooden Box, (as if ſomewhat in the Box did the feat) in which, with a Pin, they make a ſmall Hole, to receive the Beard, without letting the Croſs ſink down. Laſtly, they ask the Queſtion; as which is the faireſt Woman in the Company? or the like: and at every Queſtion they ſtick the Croſs in the Box; having firſt put it towards their Mouth, as if they charm'd it; and the Croſs ſtirs not: but when they come to the Perſon they deſign; as they hold the Croſs to their Mouth, they wet the Beard with the tip of their Tongue, and ſo ſtick the Croſs in the Box; upon which it turns ſoftly round three or four times, by the untwining of the Beard from the Moiſture [g]. This becomes more evident if you ſtick the Croſs between your Fingers. Whence it appears, that the Motion produced by ſo little Moiſture, is ſtronger than the cloſing or bending of the Head of a Marygold, *&c.*

Whence the Noon-day Dew of the Roſa Solis.

9. Tis reported, that the Herb *Roſa Solis*, will at Noon-day, when the Sun ſhines hot and bright, have a great Dew upon it; and therefore that the right Name is *Ros Solis*. This they impute to a Sympathy it has with the Sun. Men favour Wonders. It were proper firſt to be ſure, that the Dew found upon it, is not the Dew of the Morning preſerved, when the Dew of other Herbs is breath'd away; for it has a ſmooth and thick Leaf, which does not diſcharge the Dew ſo ſoon as other Herbs, that are more ſpungy

[f] Whence proceeds that extraordinary Phænomenon of the ſenſitive or humble Plant, which falls flat upon being touched; and afterwards gently riſes again?

[g] This Property of the Oat-Beard to move with ſo little Moiſture, has occaſion'd it to be choſe for making an Hygrometer, to ſhew the degree of Moiſture in the Air, after the manner of the Hand of a Dial.

ſpungy and porous [h]: and perhaps Purſlane, or ſome other Herb, does the like. But if it has more Dew at Noon, than in the Morning; then it ſeems to be an Exudation of the Herb itſelf: As Plumbs ſweat when put into the Oven.

Honey Dews, why chiefly found on Oak-Leaves.

10. 'Tis certain, that Honey-Dews are found more upon Oak-leaves than upon Aſh, Beech, or the like: but whether the Leaf has any property of concocting the Dew; or whether the Thing happens only on account of the cloſeneſs, and ſmoothneſs of the Leaf, ſeems doubtful. It ſhould be well examined, whether Manna falls only upon certain Herbs or Leaves [i]. Flowers that have deep Sockets, gather in the Bottom a kind of Honey; as Honey-ſuckles, Lillies, and the like [k]. And in theſe the Flower bears a part with the Dew.

Cucow-Spittle and Mildew.

11. The Froth call'd *Cucow-Spittle*, is found only upon certain hot Herbs; as Lavender, Sage, Hyſſop, *&c.* Enquire into the Cauſe hereof; for it ſeems a Secret [l]. Mildew alſo falls upon Corn, and ſmuts it; but the ſame falls alſo upon other Herbs, tho it is leſs obſerved.

Whether Plants will attract Water at a diſtance.

12. Let it be try'd, whether the great Conſent betwixt Plants and Water, will cauſe an Attraction at a Diſtance, as well as in Contact. In the middle of a Veſſel make a falſe Bottom of coarſe Canvas; fill the Veſſel with Earth above the Canvas, and let the Earth be kept dry; then ſow ſome good Seed in this Earth; and under the Canvas, half a Foot in the bottom of the Veſſel, place a large Spunge thoroughly wet in Water; and let it lye for ten Days; to try whether the Seeds will ſprout, the Earth become moiſter, and the Spunge more dry [m].

SECT.

[h] An accurate Obſervation of the Structure of this Plant, might, perhaps, lead to a diſcovery of the whole Myſtery. No Notice is here taken that the Leaves are ſomewhat hollow, covered all over and fringed at the Edges, with a kind of fine, ſhort, red Hairs, which give the whole Leaf a red caſt.

[i] See the *Article* MANNA.

[k] And is not this ſweet Subſtance a particular exalted Juice of the Plant, and the real Honey which Bees only collect from Flowers, and Treaſure up in their Hives?

[l] Is there not conſtantly found an Egg, Aurelia, ſmall Worm, or Maggot, within this frothy Matter? By what Creature is this Egg laid; and into what does it turn? Of what Nature is the Froth; from whence does it proceed; what is its Uſe; and how comes it not to exhale with the heat of the Sun? Laſtly, is it found only upon aromatic Plants?

[m] Has this Experiment been ſatisfactorily tried?

SECT. VI.

Of rendring Fruits and Herbs Medicinal.

The moſt likely Methods of producing alterations in Plants.

1. ATtempts for altering the Scent, Colour, or Taſte of Fruit, by infuſing, mixing, or putting into the Bark, Root, Herb, or Flower, any aromatical, colour'd, or medicinal Subſtance, are but Fancies: *for theſe Things have paſs'd their Period, and nouriſh not*[n]. And every Alteration of Vegetables in thoſe Qualities, muſt be effected by means of ſomewhat that is apt to enter the Nouriſhment of the Plant. It is certain, that where Cows feed upon wild Garlick, their Milk taſtes plainly of it: and Mutton is better taſted when the Sheep feed upon wild Thyme, and other wholeſome Herbs. *Galen* ſpeaks of curing a ſchirrous Liver, by the Milk of a Cow that feeds upon certain Herbs; the Honey in *Spain* ſmells of the Roſemary, or Orange-Tree, from whence it was gather'd: and there is an old Tradition of a Courtezan fed with *Napellus*; which, tho accounted the ſtrongeſt vegetable Poiſon, yet, thro' Uſe, did not hurt her, but by Communication poiſon'd ſome of her *Gallants*. There is obſerved an efficacious Bezoar, and another without Virtue; tho they appear alike: but the efficacious one is taken from the Beaſt that feeds where there are antidotal Herbs; and that without Virtue, from ſuch as feed where no ſuch Herbs grow. Again, ſteeped Wines, and Beers, are very medicinal; as likewiſe Bread mix'd with Powders: ſo Meat alſo, as Fleſh, Fiſh, Milk, and Eggs, may perhaps be made of great Uſe for Medicine and Diet, if the Beaſt, Fowl or Fiſh, be fed with a particular kind of Food, proper for the Diſeaſe [o]. This were dangerous Doctrine with regard to ſecret poiſoning. But whether it may be applied to Plants, I queſtion the rather becauſe their Nouriſhment is a more common Juice; ſcarce capable of any particular quality before the Plant aſſimilates it [p].

Four ways of rendring Plants medicinal.

2. But leſt our incredulity ſhould prevent any profitable Operations of this kind; eſpecially ſince many of the Ancients have ſet them down; we will briefly touch upon the four Means they have deviſed for making Plants medicinal. The *firſt* is by ſlitting the Root, and infuſing the Medicine therein; as Hellebore, Opium, Scammony, *Theriaca*, *&c.* then binding it up again. This ſeems the leſs promiſing, becauſe the Root draws immediately from the Earth; and ſo the Nouriſhment is ſtill common, and leſs qualified for the end propoſed. Beſides, 'tis thus a long time before the

[n] This is an Approximation to a very conſiderable Axiom.

[o] Numerous capital Inſtances to this purpoſe might be collected from the *Philoſophical Tranſactions*, *French Memoirs*, *German Ephemerides*, and Mr. *Boyle's Philoſophical Writings*.

[p] Hence it appears that the Author does not ſuppoſe the different Juices of Vegetables formally to exiſt in the Earth; but that they receive their ſeveral particular Properties and Virtues from the Action or Elaboration of the reſpective Plant. So that what is above delivered, as to Plants attracting different Juices from the Earth, is to be underſtood of crude, and not of concocted Juices, as they are found in the Veſſels of Vegetables. See above, *Sect.* V. 2, 3.

the Medicine reaches the Fruit. The *ſecond* is, to perforate the Body of the Tree, and then to infuſe the Medicine; which is ſomewhat better: for if any Virtue be received from the Medicine, it has thus the ſhorter and quicker aſcent. The *third* is, to ſteep the Seed or Kernel, in ſome Liquor wherein the Medicine is infuſed: which I have little Opinion of, becauſe I ſuſpect the Seed will ſcarce draw the Parts of the Matter, that have the Property: but it may be much more promiſing to mix the Medicine with Dung; becauſe the Seed naturally drawing the Moiſture of the Dung, may receive ſome of the Property along with it. The *fourth* is, the frequent watering of the Plant with an Infuſion of the Medicine. This in one reſpect may have more Force than the reſt; becauſe the Means is frequently renewed; whereas the reſt are applied but once: whence the Virtue may the ſooner vaniſh. But ſtill I ſuſpect the Root is ſomewhat too ſtubborn to receive ſuch fine Impreſſions; which have alſo a great way to aſcend. I judge therefore the likelieſt Method to be the perforation of the Body of the Tree, in ſeveral places one above another; then the filling of the Holes with Dung, mix'd with the Medicine; and watering theſe Parcels of Dung, by means of Squirts, with an Infuſion of the Medicine in dunged Water, once in three or four Days [q].

SECT. VII.

Of Curioſities in Vegetation.

1. 'TIS a Curioſity to have ſeveral Fruits upon one Tree; eſpecially when ſome of them come early, and ſome late; ſo that the ſame Tree ſhall bear ripe Fruit all the Summer. This is eaſily effected by grafting ſeveral Cions upon ſeveral Boughs of a Stock, in a good Ground, plentifully fed. Thus you may have all the kinds of Cherries, or of Plumbs, Peaches, or Apricots upon one Tree: but I conceive the diverſity of Fruits muſt be ſuch as will graft upon the ſame Stock; and therefore queſtion whether Apples, Pears, or Oranges, may be procured upon the ſame Stock whereon Plumbs are grafted [r]. *To produce different Fruits upon the ſame Tree.*

2. 'Tis alſo a Curioſity to have Fruits of ſeveral Shapes and Figures. This is eaſily procured by faſhioning them, when the Fruit is young, with Moulds of Earth or Wood. Thus you may have Cucumbers, *&c.* as long as *To produce Fruits of different Shapes.*

[q] It were eaſy to derive a particular Experiment, for Trial, from the preceding Doctrine; but it requires a Philoſophical Diſpoſition to make it. Few Gardeners would think it worth their while to keep conſtantly watering a Plant with a Solution of Opium, a Tincture of Cinnamon, a Decoction of Coloquintida, *&c.* for Months together. But unleſs ſome ſuch Experiments are tried with Care and Judgment, our Reaſon will never inform us what Effects are producible in this way.

[r] It is commonly found that the ſeveral Fruits of the ſame Species, but not different Species, are producible by engrafting on the ſame Tree. Thus it has in vain been tried to produce Nuts, Cherries, Apples, Figs, *&c.* all upon one Stock. If this be conſtantly and invariably the Caſe; what is the true phyſical Cauſe thereof?

as a Cane, as round as a Ball, or formed like a Croſs. You may alſo have Apples in the form of Pears or Lemmons. You may thus likewiſe have Fruit in the more curious Figures of Men, Beaſts, Birds, *&c.* the Moulds being made large enough to contain the whole Fruit when grown to its full ſize; otherwiſe you will ſtop its ſpreading, ſo as not to fill the Concavity, and receive the Shape deſired; as happens in Mould-works of fluid Bodies. Some doubt may ariſe, that thus keeping the Fruit from the Sun, may hurt it: but we find by common Experience, that Fruit will grow when cover'd. Perhaps alſo ſome ſmall Holes may be advantageouſly made in the Mould, to let in the Sun. And it were beſt to make the Mould in two ſeparable Parts, and glew or cement them together; that they may be open'd to take out the Fruit [r].

Inſcriptions on Trees and Fruit.

3. 'Tis a Curioſity to have Inſcriptions, or Engraving, appear on Fruit or Trees; which is eaſily procured by writing upon young Trees or Fruits with a Needle, Bodkin, or carving with a Knife: for as they grow, ſo will the Letters grow more large and graphical [s].

To adorn Trees with Flowers, &c.

4. Trees may be adorned with Flowers or Herbs, by boring their Bodies, and putting into the Holes Earth mix'd with Manure; and ſetting Seeds, Slips of Violets, Strawberries, wild Thyme, Camomile, or the like, therein: for they will thus grow in the Trees, as in Pots; tho, perhaps, they receive ſome additional Nouriſhment from the Trees [u]. The Experiment might alſo be tried with Shoots of Vines, and the Roots of red Roſes; for theſe being of a more woody Nature, will, perhaps, incorporate with the Tree itſelf.

To bring Trees into certain Shapes.

5. It is a common Curioſity to bring Trees and Shrubs into various Shapes; by moulding them within, and cutting them without. But theſe are imperfect Things; being too ſmall to keep their Figure. Large Caſtles made of Trees upon Timber Frames, with Turrets and Arches, were anciently matters of Magnificence.

To improve the Colours of Flowers.

6. Among Curioſities comes Coloration; for the preheminence in Flowers is Beauty. 'Tis obſerved, that July-flowers, Sweet-Williams, and Violets, that are coloured, if they be neglected, and neither water'd, new moulded, nor tranſplanted, will turn white: and, probably, the white, with much Culture, may turn colour'd. For the white Colour proceeds from ſcarcity of Nouriſhment; except in Flowers that are only white, and admit of no other Colour. 'Tis proper therefore to ſee what Natures accompany what Colours: whence Light may be had to induce Colours; by producing thoſe

[r] Theſe Experiments have been found to ſucceed, with regard to the Shapes of the Fruit; tho not ſo well perhaps with regard to its Goodneſs.

[s] This appears to have been an ancient Practice, and a kind of Amuſement for Lovers.

——— ———Teneriſque *meos incidere Amores*
Arboribus; *creſcent illæ, creſcetis Amores.*

It has alſo been uſed upon other occaſions. There goes a Report of a certain Pear-Tree, that had the Name of *James*, or *Ormond* upon all its Fruit. The manner how this was procured, if different from that above, may deſerve the Enquiry.

[u] Obſerve for this purpoſe to bore the Holes ſomewhat ſloping downwards, that the Mould and Moiſture may lodge.

thoſe Natures [w]. Whites are more inodorous than Flowers of the ſame Kind coloured; as in ſingle white Violets, white Roſes, white July-flowers [x], *&c.* Bloſſoms of Trees alſo, that are white, commonly prove inodorous, as Cherries, Pears, Plumbs; whereas thoſe of Apples, Crabs, Almonds and Peaches, are bluſhy, and ſmell ſweet. The *Cauſe* is, that the Subſtance which makes the Flower is the thinneſt Part of the Plant; whence alſo Flowers are of ſuch curious Colours: and if this be too ſparing and thin, it attains no ſtrength of Odour, except in ſuch Plants as are very ſucculent; which ſhould therefore rather be ſtinted in their Nouriſhment, than repleniſhed, to make them ſweet: as we find in white Satyrion, which is of a curious Odour; and in Bean-flowers, *&c.* Again, if the Plant put forth white Flowers only, and thoſe not thin or dry, they are commonly of a rank and fulſome Odour; as in Mayflowers, white Lillies, *&c.*

And Fruits.

7. On the contrary, in Berries, the Whites are commonly more delicate, and ſweet of Taſte, than the coloured: as white Grapes, white Raſberries, white Strawberries, white Currans [y], *&c.* The *Cauſe* is, that the coloured are more ſucculent, of coarſer Juices, and not ſo well concocted; whilſt the white are better proportioned to the Digeſtion of the Plant.

8. But in Fruits, the White commonly are the coarſeſt; as in Pear-Plumbs, Damaſcenes, *&c.* and the choiceſt Plumbs are black: the black Mulberry is better than the white. The Harveſt White-plumb is coarſe, and the Verdoccio and white Date-plumb, not very good, as being too watry; whereas a higher Concoction is required for Sweetneſs: and therefore all fine Plumbs are a little dry, and eaſily part from the Stone; as the Muſk-plumb, the Damaſcene-plumb, the Peach, the Apricot, *&c.* Yet ſome Fruits which grow not to be black, are of the Nature of Berries; ſweeteſt when pale: as the Heart-cherry, which inclines more to white, is ſweeter than the red; but the Morelli, more ſour [z].

Whence different coloured Flowers from the ſame Seed.

9. Sow Clove-July-flower-ſeed of one only Kind, and it will produce Flowers of different Colours; as the Seed caſually meets with Nouriſhment in the Earth: whence the Gardeners find two or three Roots among a hundred, that are rare, and of great price; as Purple; or Carnation of ſeveral Stripes: for there are very different Juices in the Earth, tho contiguous, and in one Bed [a]; and as the Seed meets with them, ſo it ſprouts. And

[w] See this Subject proſecuted by Mr. *Boyle*, in his *Experimental Hiſtory of Colours.*

[x] Perhaps the reverſe of this Obſervation is true, or the *contradictory Inſtances* numerous. Compare the white Lilly with the yellow, the white Muſk-roſe with the red; white Jeſſamin, with the yellow; the white Bloſſoms of the Pear, the Cherry, and the Plumb-tree, with the variegated ones of the Peach, Nectarine, Apple, *&c.*

[y] The *contradictory Inſtances* ſhould alſo be enumerated.

[z] Theſe Particulars, before they can be well adjuſted, ſeem to require a farther Enquiry into Colours, and the Origin and Cauſes of Forms, than is hitherto extant.

[a] Can theſe different Juices be extracted by a proper chemical Contrivance, and exhibited diſtinct to the Eye? And ſuppoſing this Difference of Juices, how do they act in cauſing a difference of Colour in the Flowers? or laſtly, may not this difference of Colour proceed from ſome Particular in the Seed; tho of the ſame general Kind with the reſt? No exact Solutions of ſuch Queries are to be expected, without a rigid *inductive Enquiry*; which few Philoſophers ſeem diſpoſed to enter upon.

I

thoſe that come up Purple, always come ſingle; the Juice, as it ſhould ſeem, not being able to allow a ſucculent Colour, and a double Leaf. This Experiment of ſeveral Colours produced from the ſame Seed, ſhould be tried alſo, in Larks-foot, Monks-hood, Poppy, and Hollyoak.

Few Fruits red.

10. Few Fruits are red within, except the Queen-apple, the Roſe-apple, Mulberries, and red Grapes; tho this is chiefly towards the Skin. There is a Peach alſo, that has a Circle of red towards the Stone; and the Morelli-cherry is ſomewhat red within; but no Pear, Plumb, or Apricot, tho they have red Sides, are red within [b].

The various Colours of Plants.

11. The general Colour of Plants is green, which no Flower is; tho there be, indeed, a pale-greeniſh Primroſe. The young Leaves of ſome Trees turn a little reddiſh; as in Oaks, Vines, and Hazles. Leaves rot into a yellow; and ſome Hollies have part of their Leaves yellow, that appear as freſh and ſhining as the green. Yellow alſo, ſeems to be a leſs ſucculent Colour than green; and a degree nearer to white. For it has been noted, that theſe yellow Leaves of Holly always ſtand towards the North, and North-eaſt. Some Roots are yellow, as Carrots; and ſome Plants blood-red, Stalk and Leaf; as the *Amaranthus*. Some Herbs incline to purple and red; as a Kind of Sage, a Kind of Mint, *Roſa Solis*, &c. And ſome have white Leaves; as another Kind of Sage, and another Kind of Mint; but Azure and a fair Purple, are never found in Leaves [c]: which ſhews, that Flowers are made of a refined Juice of the Earth, as well as Fruits; but the Leaves of a more coarſe and common one [d].

To produce double Flowers.

12. 'Tis a Curioſity to make Flowers double. This is effected by often removing them into new Earth; as, on the contrary, double Flowers, by neglect, and want of removing, become ſingle. The ſpeedy Way is, to ſow or ſet Seeds, or Slips of Flowers; and, as ſoon as they come up, to remove them into good new Ground [e]. Enquire alſo, whether inoculating of Flowers, as Stocks, Roſes, Muſk-roſes, &c. does not make them double [f]. There is a Cherry-tree that has double Bloſſoms; but it bears no Fruit: and, perhaps, the ſame Means, which, applied to the Tree, greatly accelerate the Sap in riſing, and breaking forth, will make the Tree ſpend itſelf in Flowers, and thoſe double; which would be beautiful, in Apple-trees, Peach-trees, and Almond-trees, that have bluſh-coloured Bloſſoms.

Ways for producing Fruit without Stone or Core.

13. The producing of Fruits without Core or Stone, is likewiſe a Curioſity, and ſomewhat more; becauſe whatever has this Effect, may render them

[b] Enquire into the Colour of the Blood-red tinging Grape, the prickly Pear, &c.

[c] By way of contradictory Inſtances, remember the Vetch, the Garden or Field-violet, the Paſſion-flower, the *Viola Tricolor*, &c.

[d] See the *Article* PERCOLATION.

[e] This is found to anſwer upon Trial; eſpecially when ſome of the Flowers are plucked off, that the reſt may thrive the better.

[f] The Gardeners declare it does not; the Bud inoculated conſtantly retaining its own Nature, as in the caſe of Grafting.

them more tender and delicate. But the Methods hitherto propoſed for this Purpoſe, are generally trifling and inſufficient [g].

SECT. VIII.

Of the Generation of Plants, and their Tranſmutation into one another.

The Cauſes of Degeneration in Plants.

1. 'TIS certain that Plants, for want of Culture, degenerate; and, ſometimes, ſo far as to change into another kind [h]. Long ſtanding, without removal, makes them degenerate. Drought, unleſs the Earth be moiſt, has the like Effect: ſo has removing them into worſe Earth, or forbearing to manure the Ground. Thus Water-mint turns to Field-mint, Colewort into Rape, *&c.* Whatever Fruit thrives upon a Root, or a Slip, will degenerate, if it be ſown. Grapes, Figs, Almonds, and Pomgranate-kernels ſown, make the Fruits degenerate and become wild. Again, moſt of thoſe Fruits that uſe to be grafted degenerate, if Set of Kernels, or Stone. Peaches indeed ſucceed better from the Stone, than upon Grafting [i]: and the Rule of Exception ſeems to be this, that whatever Plant requires much Moiſture, proſpers better upon the Stone or Kernel, than upon the Graft. For the Stock, tho it gives a finer Nourniſhment, yet gives leſs than the Earth at large. Seeds, if very old, and yet of ſtrength to produce a Plant, make the Plant degenerate; therefore ſkilful Gardeners try their Seeds before they buy them, by putting them into Water as it is gently boiling; for, if good, they will new ſprout within half an Hour [k].

The ſame Seed degenerates by often ſowing in the ſame Ground.

2. There goes an Opinion, that if the ſame Ground be often ſown with the ſame Grain, the Grain, in the end, becomes of a baſer Kind. In very barren

[g] Theſe Methods turn upon preventing the growth or increaſe of the Pith of the Tree; from whence the Stone and Core of the Fruit have been ſuppoſed to proceed; conſtantly watering with warm Water; Grafting a ſour Fruit upon a ſweeter Stock; and all the known Means of converting wild Trees into Garden ones. But nothing of this kind is ſaid to be effectual. And indeed, this Buſineſs of Exoſſiculation appears difficult; and, if performed, might be a capital Inſtance of the human Power over Nature. An Inſtance of Approximation we have in the Caſtration of Animals; which makes them thrive better, and grow fatter. Were it not for ſuch Inſtances, the Undertaking might ſeem deſperate; as tending to deprive the Fruit of its Seed; and weakening, croſſing, and deſtroying, inſtead of ſtrengthening, invigorating, and co-operating with Nature. But what Inſtances of Encouragement are there in Vegetables themſelves? Barberries have been ſometimes found without Stones; but then they uſually appear in a ſhrunk or withered State. The Inſtances of this kind ſhould be collected, and the proper manner and time of Caſtration thought of in Imitation of the Operation in living Creatures; till a more commanding Knowledge be gained of the *Nature* and *Forms* of Vegetables.

[h] It deſerves to be carefully obſerved, whether Plants by degenerating actually change their Species.

[i] But, if Inoculating be uſed inſtead of Grafting, the caſe is otherwiſe.

[k] The heavieſt Seeds, or ſuch as ſink the faſteſt in Water, are uſually eſteemed the beſt for ſowing.

barren Years, the Corn that is ſown, becomes of a different kind [l]. And 'tis a Rule, that Plants produced by Culture, as Corn, will ſooner change into another Species, than thoſe that come of themſelves; for Culture gives but an adventitious Nature, which is more eaſily put off [m].

The Tranſmutation of Plants poſſible.

3. The Tranſmutation of Plants one into another, is *a capital Work of Nature*; the Tranſmutation of Species being pronounced impoſſible. 'Tis a thing of difficulty, and requires deep Search into Nature; but, as there appear ſome manifeſt Inſtances of it [n], the Opinion of Impoſſibility is here to be rejected, and the Means to be ſought.

Rules for effecting it.

4. In order to change one Plant into another, *the Nouriſhment muſt overrule the Seed; and therefore the thing ſhould be attempted by Nouriſhments as contrary as poſſible to the Nature of the Plant; yet ſo as it may grow: and with Seeds of the weakeſt ſort, or that have the leaſt Vigour.* It were therefore proper to plant ſedgy Herbs in hilly or champain Ground; and ſuch Herbs as require much Moiſture, upon ſandy and very dry Ground: for Example; Marſh-mallows and Reeds, upon Hills; Cucumbers, Lettuce, and Colewort, upon Sand. On the other hand, plant Buſhes, Heath, Ling, and Brakes, in wet or marſhy Ground. I conceive likewiſe, that all eſculent and garden Herbs, ſet upon the tops of Hills, prove more medicinal, tho leſs eſculent than before [o]. Perhaps alſo, ſome wild Herbs will make Sallad-herbs. This is the *firſt Rule* for the Tranſmutation of Plants.

Rule 1.

Rule 2.

5. The *ſecond Rule* may be, to ſet ſome few Seeds of the Herb to be changed, among other Seeds; to try whether the Juice of theſe other Seeds will not ſo qualify the Earth, as to alter the Seed to be operated upon: for example; ſow Parſley-ſeed among Onion-ſeed, or Lettuce-ſeed among Parſley-ſeed; and try if, by this means, there will be any change of Taſte, or otherwiſe. But it were proper to ſeparate the Seed deſigned to be changed, from the foreign Seed, by the Interpoſition of a piece of Linen.

Rule 3.

6. The *third Rule* may be, the making ſome Mixture of Earth with other Plants bruiſed, either in Leaf or Root: for example, make up Earth with a Mixture of Colewort-Leaves ſtamped, and ſet Artichoaks, or Parſnips in it; or take Earth mixed with Marjoram, Origanum, or Wild-thyme bruiſed, and ſet in it Fennel-ſeed, *&c.* It is not here deſigned, that the Herb to be wrought upon, ſhould draw the Juice of the foreign Herb; but, I conceive, there will be a new Preparation of Mould, which, perhaps, may alter the Seed from the Kind of the former Herb.

7. The

[l] *Grandia ſæpe quibus mandavimus hordia Sulcis,*
Infelix Lolium, & ſteriles dominantur Avenæ.

[m] Theſe Particulars require to be diligently examined into. See Dr. *Sharrock's Hiſtory of the Propagation and Improvement of Vegetables, by the concurrence of Art and Nature,* Pag. 28, *&c.*

[n] Let theſe Inſtances be enumerated, and carefully examined; as to their Certainty and Juſtneſs.

[o] How is this found upon the Hills about *Montpellier* in *France?*

7. The *fourth Rule* may be, to mark what Herbs ſome Earths produce ſpontaneouſly; and to pot or veſſel up that Earth, and in it ſet the Seed you would change. Thus take Earth from under Walls, or the like, where Nettles grow in abundance, without any String or Root of the Nettles; pot that Earth, and ſet in it Stock-July-flowers, or Wall-flowers; or ſow the Seeds of them therein; and try the Event. Or take Earth prepared to put forth Muſhrooms of itſelf; and ſow therein Purſlane, or Lettuce-ſeed: for in theſe Experiments, 'tis probable, that the Earth being accuſtomed to afford one kind of Nouriſhment, will alter the new Seed. *Rule 4.*

8. Let the *fifth Rule* be, to make the Herb grow contrary to its Nature; as to make ground Herbs riſe in height. Thus carry Camomile, Wild-thyme, or the green Strawberry, upon Sticks, as they do Hops upon Poles; and obſerve the iſſue. *Rule 5.*

9. Let a *ſixth Rule* be, to make Plants grow out of the Sun's reach; for this is a great Change in Nature, and may induce a Change in the Seed. Thus, barrel up Earth, ſow ſome Seed in it, and place it at the bottom of a Pond, or a great hollow Tree. Try alſo, the ſowing of Seeds in the bottoms of Caves; and Pots with Seeds ſown, hung in Wells, ſome diſtance from the Water, and obſerve the Event [p]. *Rule 6.*

SECT. IX.

Of the Tallneſs, Lowneſs, and artificial Dwarfing of Trees.

1. TImber-Trees, in Coppice Woods, grow more upright, and freer from under Boughs, than thoſe in the Field: Vegetables having a natural Motion of riſing to the Sun. Beſides, they are not glutted with too much Nouriſhment; becauſe the Coppice ſhares with them: and *Repletion always hinders Stature* [q]. Laſtly, they are kept warm; which, in Plants, conſtantly promotes their mounting. *Whence the Tallneſs of Trees in Coppices.*

2. Trees that are full of Heat, which appears by their inflammable Gums, as Firs and Pines, mount in height, without ſhooting out ſide Boughs, till towards the Top. The *Cauſe* is, partly Heat, and partly tenuity of Juice; both which drive the Sap upwards. As for Juniper, 'tis but a Shrub; and grows not large enough in the Body to maintain a tall Tree. *Why hot Trees have tall Trunks.*

3. *'Tis reported*, that a ſtrong Canvas ſpread over a low-grafted Tree, ſoon after it ſhoots, will dwarf it, and make it ſpread. The *Cauſe* is manifeſt; for all things that grow, muſt grow as they find room [r]. *The dwarfing of Trees by Covering.*

4. Trees

[p] Obſerve that theſe are not propoſed as perfect *Rules*; which put in practice ſhall certainly produce the Effect; but only as Attempts, by means of certain well adapted *Experiments*, to diſcover ſuch *Rules*.

[q] Is this *Axiom* ſufficiently verified? If it be, it affords a Rule for producing conſiderable Effects.

[r] This Experiment is found to anſwer; ſo that Fruit-trees may be thus dwarfed to advantage; and alſo have their Fruit preſerved both from the ſcorching Sun, and the Birds.

By planting Slips.

4. Trees are generally ſet from Roots, or Kernels; but if from Slips, as particularly the Mulberry, ſome of the Slips will grow; and, 'tis ſaid, become Dwarf-Trees: becauſe a Slip draws Nouriſhment weaker than a Root or Kernel [r].

The Requiſites to Dwarfing.

5. All Plants that put forth their Sap haſtily, have their Bodies not proportionable to their length, and are therefore Winders and Creepers; as Ivy, Bryony, Hops, Woodbine, *&c.* whereas Dwarfing requires the Sap to riſe ſlow, and a leſs Vigour in mounting.

SECT. X.

Of the Rudiments and Excreſcencies of Plants.

The Nature and Growth of Moſs.

1. *Solomon* wrote a *Natural Hiſtory* from the *Cedar of Libanus* to the *Moſs* growing upon the Wall. And indeed *Moſs* is but the Rudiment of a Plant, growing chiefly upon Ridges of Houſes, whether tiled or thatched; and upon the Creſts of Walls: and this Moſs is of a lightſome and pleaſant Green. It grows upon Slopes; becauſe, as it proceeds from Moiſture and Water, ſo the Water muſt ſlide, and not ſtand or ſtagnate. And its growing upon Tiles, or Walls, *&c.* proceeds from hence; that thoſe dried Earths, having not Moiſture ſufficient to put forth Plants, practiſe Germination by putting forth Moſs: tho, when by Age, or otherwiſe, they relent and reſolve, they ſometimes put forth Plants; ſuch as Wallflowers. And almoſt all Moſs has here and there little Stalks, beſides the low Thrum.

Where it chiefly riſes.

2. Moſs grows upon Walks, eſpecially ſuch as are cold, and expoſed to the North; as in divers Terraſſes, if they be trodden, or if they were, at firſt, gravelled; for wherever Plants are kept down, the Earth puts forth Moſs.

Grows on old Ground, and old Trees.

3. Old Ground that has long lain fallow, gathers Moſs: whence Huſbandmen cure their Paſture-grounds when they grow to Moſs, by Tilling them for a Year or two; which alſo depends upon the ſame *Cauſe:* as the more ſparing and ſtarving Juice of the Earth, which is inſufficient for Plants, breeds Moſs. And old Trees are more moſſy than young ones; the Sap being not ſo vigorous as all to riſe to the Boughs; but grows languid by the way, and puts out Moſs.

And near Fountains.

4. Fountains have Moſs growing about them: for Fountains drain the Water from the adjacent Ground, and leave but ſufficient Moiſture to breed Moſs; whereto the coldneſs of the Water alſo conduces.

The Moſs of Trees, what.

5. The Moſs of Trees is a kind of Hair, or the Juice of the Tree ſecreted, that does not aſſimilate: and upon great Trees, the Moſs grows in a Figure, like a Leaf.

6. The

[r] Do not thoſe Trees that will grow from Slips, naturally become Dwarfs, if all their Side-ſhoots are ſuffered to grow without cutting?

6. The moiſter ſort of Trees yield little Moſs; as Aſps, Poplars, Willows, Beeches, *&c.* partly becauſe of the quick riſing of the Sap into the Boughs; and partly becauſe the Barks of theſe Trees are more cloſe and ſmooth than thoſe of Oaks and Aſhes; whence the Moſs can hardly iſſue out. *Why moiſt Trees yield little Moſs.*

7. All Fruit-Trees grow full of Moſs in Clay Grounds, both upon the Body and Boughs; partly from the coldneſs of the Ground, whence the Plants are nouriſhed leſs; and partly from the toughneſs of the Earth, whereby the Sap is confined, and cannot get up to ſpread freely. *Why Trees grow moſſy in Clay Grounds.*

8. We have already obſerved, that if Trees be Bark-bound, they grow leſs fruitful, and gather Moſs; and that they are cured by hacking [t], *&c.* On the contrary, if Trees be bound in with Cords, they will put forth more Moſs: which alſo happens to Trees that ſtand bleak. It ſhould alſo be tried, whether a Tree covered ſomewhat thick upon the top, after polling, will not gather more Moſs. I judge alſo, that to water Trees with cold Spring-water, makes them grow moſſy. *Experiments for making Trees moſſy.*

9. The Perfumers have a Moſs yielded by the Apple-tree, and of an excellent Odour [u]. The manner of its Growth and Nature ſhould be enquired after. For the ſake of this Moſs, it being a thing of Price, I have, above, ſet down the Ways of multiplying Moſſes [x]. *Apple-tree Moſs, a Perfume.*

10. Next to Moſs come *Muſhrooms*; which are likewiſe an imperfect Plant. Muſhrooms have two ſtrange Properties; the one, that they yield a delicious Meat; the other, that they come up in a Night; and yet are unſown. They muſt neceſſarily, therefore, be made of much Moiſture; and that Moiſture fat and groſs, yet ſomewhat concocted. And indeed we find, that Muſhrooms cauſe what they call the *Incubus*, or *Night-mare*, in the Stomach: whence a Surfeit of them may ſuffocate and poiſon [y]. This ſhews they are windy, and that Windineſs groſs and ſwelling; not ſharp or griping. And, for the ſame reaſon, *Muſhrooms* are provocative. *Muſhrooms have two extraordinary Properties.*

11. 'Tis reported, that the Bark of white or red Poplar, cut ſmall, caſt into Furrows, and well dunged, will cauſe the Ground to put forth Muſhrooms, at all Seaſons of the Year, fit for eating. Some add to the Mixture, Baker's Leaven diſſolved in Water. And, it is ſaid, that if a hilly Field where the Stubble is ſtanding, be ſet on fire in a ſhowry Seaſon, it will afford great ſtore of Muſhrooms. 'Tis alſo ſaid, that Hartſhorn-ſhavings mixed with Dung, and watered, yield Muſhrooms; and Hartſhorn is of a fat and clammy Subſtance: perhaps, Ox-horn would do the like [z]. *The ways of producing Muſhrooms.*

12. There

[t] See above, *Sect.* III. 6, 15.

[u] This Moſs ſeems to be a caſual Thing upon Apple-trees, that is not often to be found; and perhaps depends on a certain ſmall degree of Putrefaction in the Moſs.

[x] There is a curious Account of the *Moſſes* in *Scotland*, to be found in the *Philoſophical Tranſactions*, Numb. 330.

[y] There are ſeveral Species of Muſhrooms; but have the red-gill'd Species ever been found poiſonous, pernicious, or ſurfeiting?

[z] Great Light is given to this whole Affair of *Muſhrooms*, by the *Memoirs of the Royal Academy of Sciences at* Paris. See in particular, for the Year 1707. *Hiſt.* pag. 46. and *Memoir.* p. 58.

12. There is no known Subſtance but Earth, and the Produces thereof, as Tiles, Stones, *&c.* that yields any Moſs, or herby Subſtance. Trial may be made, by putting Seeds into little Holes bored in the Horns of Stags, or Oxen, to ſee if they will grow [a].

The Growth of Toad-ſtools.

13. There is another imperfect Plant, to appearance like a great Muſhroom; ſometimes as broad as a Hat, and called a Toad's-ſtool: but 'tis not eſculent; and commonly grows adjacent to the dead Stump of a Tree, or the Roots of rotten Trees: and therefore ſeems to take its Juice from putrefied Wood. Which ſhews, by the way, that putrefied Wood yields a free Moiſture [b].

A Cake-like Excreſcence on Trees.

14. There is a nameleſs Cake that grows upon the Side of a dead Tree, large, of a Cheſtnut colour, hard and pithy [c]; whence it ſhould ſeem, that even dead Trees continue to put forth, as the dead Bodies of Men do Hair and Nails for a time.

The Fuz-ball.

15. There is a Bug, or Fuzzy-ball, growing common in the Fields, that at the firſt is hard, like a Tennis-ball, and white; but after grows of a Muſhroom-colour, and full of light Duſt upon the breaking: 'tis thought to be dangerous to the Eyes, if the Powder gets into them; and good for Kibes: being probably of a corroſive and fretting Nature [d].

Jews-ear.

16. There is an Excreſcence, called *Jews-ear*, that grows upon the Roots, and lower parts of Trees, eſpecially of Elder, and ſometimes upon Aſh. It has a ſtrange Property; for, in warm Water, it ſwells and opens extremely. 'Tis of a duſky-brown colour, and uſed in the *Quinſy* and *Inflammations of the Throat*; whence it ſeems to have a mollifying Virtue [e].

Agarick.

17. There is alſo a kind of ſpongy Excreſcence, growing chiefly upon the Roots of the Laſer-tree, and ſometimes upon Cedars, *&c.* 'Tis very white, light and friable; we call it *Agarick*, and 'tis famous in Phyſick, for purging viſcid Phlegm. 'Tis alſo an excellent Opener of the Liver; but offenſive to the Stomach, and the Taſte: being firſt ſweet, and afterwards bitter.

The Hiſtory of Miſſeltoe.

18. We find no *Super-plant* that is fairly formed and figured, except *Miſſeltoe*: as to which we have an idle Tradition of a Bird, called a *Miſſel-bird*, that feeds upon a Seed ſhe cannot digeſt, and ſo expels it whole with her Excrement; which falling upon the Bough of a Tree, produces the Miſſeltoe. But this is a Fable; it being not probable that Birds ſhould feed upon what they cannot digeſt. Beſides, *Miſſeltoe* is found but upon certain Trees, that bear no Fruit to allure that Bird, which feeding upon the *Miſſeltoe-berries*,

[a] What are the *Inſtances of Approach* in this caſe? Conſider of the Vegetation upon the white Cake of Salt left after the Diſtillation of *Glauber's* Spirit of Nitre. Conſider alſo, the Growth of Muſhrooms upon Chirurgeons Dreſſings, *&c.* See the *French Memoirs* in the Places above quoted.

[b] See *Philoſoph. Tranſact.* Numb. 330.

[c] Is not this Leather-like Excreſcence, ſomewhat analogous to the *Noſtock*, or *Star-ſhoot?*

[d] This is the *Crepitus Lupi*, or common Fuz-ball; and ſaid to be a powerful Styptic.

[e] It has alſo a particular faintiſh Odour, when boiled; and then ſomewhat reſembles a piece of black, well-dreſſed, ſupple Leather.

berries, and therefore being often found there, may have given occaſion to the Tale. But what ends the Diſpute is, that *Miſſeltoe* has been found under the Boughs, and not only above them; ſo that it cannot proceed from any thing that falls upon the Boughs. It chiefly grows upon Crab-trees, Apple-trees, ſometimes upon Hazels, and rarely upon Oaks[f]; the Miſſeltoe whereof is accounted very medicinal[g]. 'Tis an Evergreen, that bears a white glittering Berry, and differs entirely from the Tree whereon it grows. Two things therefore, may be hence collected: *Firſt*, that Superfœtation proceeds from plenty of Sap in the Bough. *Secondly*, that the Sap muſt be ſuch as the Tree diſcharges, and cannot aſſimilate; elſe it would go into a Bough: and beſides, it ſeems more fat and unctuous than the ordinary Sap of the Tree; both by the Berry, which is clammy, and becauſe it continues green, Winter and Summer, which the Tree does not[h].

Experiments derived from it.

19. This Obſervation upon *Miſſeltoe*, may give ſome light to other Practices. Trial therefore ſhould be made, by ripping the Bough of a Crab-tree in the Bark, and watering the Inciſion every day with warm Dung-water; to ſee if it will produce Miſſeltoe, or any thing like it: but it were yet more promiſing, to try it with other Watering and Anointing, leſs natural to the Tree; as Oil, Beer, Yeaſt, *&c.* provided they be ſuch as do not kill the Bough.

How Plants will grow that do not ſhoot in Boughs.

20. It were proper to try how Plants would grow, if prevented from Shooting their natural Boughs. Poll a Tree therefore, and cover it thick with Clay on the Top; and mark the Event. I ſuppoſe it will put forth in Roots; for ſo a Cion will, being turned down into Clay. Therefore, in this Experiment alſo, the Tree ſhould be cloſed with ſomewhat not ſo natural to it as Clay. Try Leather, Cloth, or Painting; provided it be not hurtful to the Tree. 'Tis certain that a Brake has grown out of a Pollard[i].

The Prickles of Trees, what.

21. The Prickles of Trees ſeem to be a kind of Excreſcence; for they will never become Boughs, nor bear Leaves. The Vegetables that have Prickles, are the black and white Thorn, the Briar, the Roſe, the Crab-tree, the Gooſberry, the Barberry; theſe have it in the Bough. The Plants that have Prickles in the Leaf, are Holly, Juniper, Whin, Thiſtle; Nettles alſo have a ſmall venomous Prickle; as Borage has a harmleſs one. The *Cauſe* ſeems to be haſty Shooting, want of Moiſture, and cloſeneſs of Bark: for the haſte of the Spirit to put forth a Bough; the want of Nouriſhment for the Purpoſe: and the cloſeneſs of the Bark, produces Prickles in Boughs: whence they are always pyramidal; the Moiſture ſpending itſelf after a little Shooting. Prickles in Leaves, come alſo from putting more Juice into the Leaf than can ſpread ſmooth therein; and therefore

[f] Its Growth upon the Oak has been queſtioned. I once ſaw it in conſiderable plenty, growing upon a very young Oak; which, for the Curioſity, was ſold at an extraordinary Price, to an Apothecary of *London*.

[g] What Certainty is there in the Relation of its being ſpecific in the *Epilepſy*?

[h] For a farther Account of *Miſſeltoe*, ſee the *Philoſophical Tranſactions*, Numb. 251, *&c.*

[i] The manner wherein, ſhould be examined.

the Leaves are otherwiſe rough; as in Borage and Nettles. The Leaves of Holly are ſmooth, yet never plain; but, as it were, folded, for the ſame Reaſon.

The Cauſe of Down on Plants.

22. There are alſo Plants, which, tho they have no Prickles, yet have a kind of downy or velvet Covering upon their Leaves; as Roſe-campion, Stocks, Colts-foot, *&c.* which Down or Nap proceeds from a ſubtile Spirit, in a ſoſt or fat Subſtance; for both Stock-July-flowers, and Roſe-campion, ſtamped, have been ſucceſsfully applied to the Wriſts, in *Tertian* or *Quartan Agues:* and the Vapour of Colts-foot is healing to the Lungs; as the Leaf alſo, is healing in Chirurgery.

Other Excreſcences in Trees.

23. Another kind of Excreſcence is an Exudation of Plants, joined with Putrefaction; as in Oak-apples, which are found chiefly upon the Leaves of Oaks, and Willows. The Country-people have a kind of Prediction, that if the Oak-apple, when broken, be full of Worms, 'tis a Sign of a peſtilential Year; which ſeems probable, becauſe they proceed from Corruption. There is alſo, upon Brier, a fine Tuft, or Buſh of Moſs, differently coloured; which if cut, is always found full of little white Worms [k].

SECT. XI.

Of the Production of perfect Plants, without Seeds.

That Earth will produce Plants without ſowing.

1. EArth taken from the Bottom of Vaults, Houſes, and Wells, and put into Pots, will afford various Kinds of Herbs; but ſome time is required for the Germination: If taken from a Fathom deep, it will put forth the firſt Year; if much deeper, not till a Year or two after. The Nature of Plants growing in the Earth ſo taken up, follows the Nature of the Mould: if the Mould be ſoft and fine, it produces ſoft Herbs; as Graſs, Plantain, *&c.* and if harder and coarſer, Herbs more rough; as Thiſtles, Furz, *&c.* It is common Experience, that in Alleys cloſe gravelled, the Earth brings forth, the firſt Year, Knot-graſs; and afterward Spire-graſs: for the hard Gravel or Pebble, at the firſt laying, will not ſuffer the Graſs to come out upright; but turns it, to find its way where it can: but when the Earth is ſomewhat looſned at the Top, the ordinary Graſs comes up. And it is reported, that Earth taken, at ſome depth, out of ſhady and damp Woods, and potted, will produce Herbs of a fat and juicy Subſtance; as Penny-wort, Purſlane, Houſleek, Penny-royal, *&c.*

That Water produces Plants.

2. Water alſo yields Plants that have no Roots fixed to the Bottom: but theſe are leſs perfect Plants; being chiefly Leaves, and ſmall ones, ſuch as Duck-weed; which has a Leaf no bigger than Thyme, but of a freſher green, and ſhoots a little String into the Water, far from the Bottom. The Water-lilly has its Root in the Ground; ſo have many other Herbs that grow in Ponds.

3. 'Tis

[k] Purſuant to the Deſign, all the other Excreſcences of Vegetables ſhould be here enumerated, even thoſe diſcovered by the Microſcope. See Dr. *Hook's Micrographia.*

3. 'Tis reported likewiſe, that ſome Plants grow upon the Top of the Sea; being ſuppoſed to proceed from a certain Concretion of Slime in the Water, when the Sun beats hot, and the Sea ſtirs little. As for Sea-weed and Sea-thiſtle, they both have Roots; but the Sea-weed under the Water; and the Sea-thiſtle upon the Shore. *Plants growing on the Sea.*

4. The Ancients have noted, that ſome Herbs grow out of Snow, laid up cloſe together and putrefied; and that they are all bitter: they name one, in particular, *Flomus*, which we call Moth-mullein. And Worms are frequently found in Snow, like Earth-worms; whence, poſſibly, it may likewiſe yield Plants. *In Snow.*

5. The Ancients alſo affirm, that ſome Herbs grow out of Stone: which may be; for Toads have been found in the middle of Free-ſtone. We alſo ſee, that Flints lying above ground, gather Moſs; and ſome Flowers grow upon Walls; but whether upon the main Brick, or Stone, or whether out of the Lime or Chinks, is not well obſerved: for Elders and Aſhes have been ſeen growing out of Steeples, tho manifeſtly from the Clefts; inſomuch that when they grow large, they will disjoin the Stones. There are likewiſe Rock-herbs; but, I ſuppoſe, only where there is ſome Mould or Earth. It has likewiſe been found, that great Trees, growing upon Quarries, have ſhot down their Root into the Stone. *In Stone.*

6. 'Tis reported, that in ſome Mines of *Germany*, there grow Vegetables at the Bottom; and, the Workmen ſay, they have a magical Virtue, and will not ſuffer them to be gathered. *At the Bottom of Mines.*

7. The Sea-ſand ſeldom bears Plants; becauſe the Sun exhales the Moiſture before it can incorporate with the Earth, and yield a Nouriſhment for Plants. 'Tis alſo affirmed, that Sand has its Root in Clay; and that there are no Veins of Sand any great depth within the Earth[1]. *And but ſeldom in Sands.*

SECT. XII.

Of Exotick Plants.

1. 'TIS reported, that Earth brought from the *Indies*, and other remote Countries, by way of Ballaſt, being thrown upon ſome Ground in *Italy*, produced foreign Herbs, unknown to us in *Europe*; and that from their Roots, Barks and Seeds bruiſed together, mixed with Earth, and well watered with warm Water, there came forth Herbs much like the other. *Foreign Earth producing foreign Plants in* Europe.

[1] None of the Inſtances here produced, make expreſly for the *Title*; viz. *The Production of perfect Plants without Seed*; but only for their Production without the Seed being ſown by Men. But there are many ways of ſowing Seed, by the means of Birds, Beaſts, Winds, the ſpontaneous burſting of Flowers, *&c.* all which deſerve to be enumerated. And perhaps it will at length be found, that every Species of Vegetables, even Muſhrooms, have their Seed, and are propagated by means thereof. See the Account of *Maſhrooms* in the *French Memoirs.*

How to preſerve the Exoticks of hot Countries.

2. Plants brought out of hot Countries, endeavour to put forth at the ſame time they uſually do in their own Climate: therefore, to preſerve them, there is no more required, than to keep them from being put back by Cold. 'Tis alſo reported, that Grain tranſplanted from a hot Country to a colder, will be more forward than the ordinary Grain of the cold Country. This may ſucceed better in Grain than in Trees; becauſe Grain is but annual, and ſo the Virtue of the Seed is not worn out; whereas a Tree is debaſed by the Ground whereto it is removed.

Orange and Lemmon Seed yielding Sallading.

3. Many Plants which grow in the hotter Countries, will, if ſown of Seed, late in the Spring, come up and endure moſt part of the Summer; as we find in Oranges, Lemmons, *&c.* the Seed whereof, ſown at the end of *April*, yields excellent Sallads, mixed with other Herbs. And, I conceive, that the Seeds of Clove, Pepper, *&c.* if they could be had green enough to be ſown, would do the like [m].

SECT. XIII.

Of the Seaſons of Plants.

The earlieſt Flowers.

1. SOME Flowers, Bloſſoms, Grains, and Fruits, come early, and others late in the Year. The early Flowers, with us, are Primroſes, Violets, Anemonies, Water-daffadils, the *Crocus Vernus*, and ſome Tulips. Theſe are all cold Plants; which therefore ſeem to have a quicker Perception of the heat of the Sun than hot Herbs have: as a cold Hand ſooner perceives a little warmth than a hot one. Thoſe that come next in order, are Wall-flowers, Cowſlips, Hyacinths, Roſemary-flowers, *&c.* then Pinks, Roſes, the Flower-deluce, *&c.* The lateſt are July-flowers, Holly-oaks, Larks-foot, *&c.*

The next in order.

The lateſt.

The earlieſt Bloſſoms.

2. The earlieſt Bloſſoms are thoſe of the Peach, Almond, Cornelian, Mezereon, *&c.* being of ſuch Trees as have much Moiſture, either watery or oily. Whence the *Crocus Vernus* alſo, an Herb that has an oily Juice, puts forth early; for theſe likewiſe find the Sun ſooner than the drier Trees.

The order wherein Grain ripens.

3. Of the Grains, the firſt are Rye, and Wheat; the next Oats, and Barly; then Peas and Beans: for tho green Peas and Beans are eaten ſooner; yet the dry ones uſed for Horſes, are ripe laſt: and it ſeems, that the latter Grain comes firſt.

The order wherein Fruit ripens.

4. The earlieſt Fruits are Strawberries, Cherries, Gooſeberries, Currans, certain Apples, Pears, Apricots, Raſberries; and after theſe, Damaſcenes, moſt kinds of Plumbs, Peaches, *&c.* the lateſt are Winter-apples, Wardens, Grapes, Nuts, Quinces, Almonds, Sloes, Briar-berries, Hips, Medlars, Services, Cornelians, *&c.*

5. Com-

[m] This *Article* of *Exoticks* remains very deficient. In order to ſupply it, conſult the Botanical Papers of the *Philoſophical Tranſactions*; *French Memoirs*; and *German Ephemerides*.

5. Commonly Trees that ripen lateſt, bloſſom ſooneſt; as Peaches, Sloes, Almonds, *&c.* and it ſeems a Work of Providence, that they bloſſom ſo ſoon; as they could not, otherwiſe, have the Sun long enough to ripen [n]. *Trees that ripen lateſt, bloſſom ſooneſt.*

6. Some Fruits come twice a-year; as certain Pears [o], Strawberries, *&c.* and they ſeem ſuch as abound with Nouriſhment; whence, after one Period, before the Sun grows too weak, they can endure another. The Violet alſo, among Flowers, comes twice a-year, eſpecially the double-white: and this alſo is a Plant full of Moiſture. Roſes alſo come twice; but not without cutting. *Some Fruits and Flowers come twice a-year.*

7. In *Muſcovy*, tho the Corn come not up till late Spring, yet their Harveſt is as early as ours; becauſe the ſtrength of the Ground is kept in by the Snow: and with us, if it be a long Winter, 'tis commonly a plentiful Year. After ſuch Winters likewiſe, the Flowers and Corn, both earlier and later, come commonly at the ſame time; which often proves troubleſome to the Huſbandman. Sometimes Red-roſes and Damaſk-roſes come together. So likewiſe the Harveſt of Wheat and Barly. But this always happens, becauſe the earlier ſtays for the later; and not, that the later comes ſooner. *Whence an early Summer in* Ruſſia.

8. Many Fruit-trees, in hot Countries, bear Bloſſoms, young Fruit, and ripe Fruit, almoſt all the Year ſucceſſively [p]. And 'tis ſaid, the Orange and the Fig do the like with us, for a great part of Summer. And no doubt this is the natural Motion of Plants; but either wanting Juice to ſpend, or meeting with the Cold of the Winter; this Circle of Ripening cannot take place, but in ſucculent Plants and hot Countries [q]. *Whence Fruit and Bloſſoms come together.*

9. Some Herbs are annual, and die, Root and all, once a-year; as Borage, Lettuce, Cucumbers, Muſk-melons, Baſil, Tobacco, Muſtard, and all kinds of Corn. Some continue many Years; as Hyſſop, Germander, Lavender, Fennel, *&c.* There are two *Cauſes* of this dying: the firſt is, the tenderneſs and weakneſs of the Seed, which makes the Period in a ſmall time; as in Borage, Lettuce, Cucumbers, Corn, *&c.* and therefore none of theſe are hot. The other is, becauſe ſome Herbs can leſs endure Cold; as Baſil, Tobacco, Muſtard-ſeed: all which have much Heat. *Whence ſome Plants are annual, and others not.*

SECT.

[n] Let the *Contradictory Inſtances* be ſought.

[o] The Windſor-Pear, for Inſtance.

[p] Particularly in *Bermudas*.

[q] How near can Art approach this natural Advantage of Climate? Let a proper *Thermometer* be contrived to regulate the Heat of a Green-houſe: and let the natural Reciprocation of Warmth, Coolneſs, Moiſture, and freſh Air, be imitated to Exactneſs.

SECT. XIV.

Of the Duration of Herbs and Trees.

What Vegetables are moſt durable.

1. VEgetables of the largeſt Body are moſt durable; as Oak, Elm, Cheſtnut, *&c.* This holds in Trees; but in Herbs 'tis often otherwiſe: for Borage, Colewort, and Pompions, which are Herbs of the largeſt Size, are of ſmall Duration; whereas Hyſſop, Winter-ſavoury, Germander, Thyme, and Sage, will laſt long. The Reaſon is, becauſe Trees laſt according to the Strength and Quantity of their Sap; being well defended by their Bark, againſt the Injuries of the Air: but Herbs draw a weak Juice, and have a ſoft Stalk; and therefore thoſe among them that laſt longeſt, have a ſtrong Smell, and a woody Stalk.

Maſt-Trees laſting.

2. Trees that bear Maſt, and Nuts, are commonly more laſting than ſuch as bear Fruits; eſpecially the moiſter Fruits: thus the Oak, Beech, Cheſtnut, Walnut, Almond, Pine, *&c.* laſt longer than the Apple-tree, the Pear-tree, *&c.* becauſe of the fatneſs and oilineſs of the Sap; which always waſtes leſs than the more watery.

Late Trees the more durable.

3. Trees that put forth their Leaves late, and alſo ſhed them late in the Year, are more durable than ſuch as ſprout early, or ſhed betimes: for the coming late ſhews a Moiſture more fixed; the other more looſe, and eaſier reſolved. For the ſame Reaſon, wild Trees laſt longer than than garden Trees; and of the ſame Kind, ſuch as have acid Fruit, longer ſuch as have a ſweet one.

Frequent cutting preſerves Trees.

4. Nothing makes Trees, Buſhes, and Herbs more durable than frequent cutting. This always cauſes a renovation of the Sap, which now neither goes ſo far, nor riſes ſo faintly, as when the Plant is not cut: inſomuch that annual Plants, if ſeaſonably cut, and ſuffered to come up ſtill young, will laſt more Years than one; as Lettuce, Purſlane, Cucumber, and the like. And for great Trees, nearly all over-grown ones in Church-yards, or adjacent to ancient Buildings, are Pollards, or Dottards; and not at their full height [r].

Experiments for making Plants more durable.

5. Experiment ſhould be made, to render Plants more laſting than their ordinary Period; as to make a Stalk of Wheat, *&c.* laſt a whole Year; ſo as that the Winter may not kill it: for we ſpeak only of prolonging the natural Period. I conceive, that whatever makes an Herb come later than at its time, will make it laſt longer. It were proper to try this in a Stalk of Wheat, ſet in the Shade, and encompaſſed with a Caſe of Wood, not touching the Straw, to keep out the open Air [s].

SECT.

[r] On this depends the Advantage of *Pruning*; which, if skilfully performed, always adds new Life and Vigour to the Tree.

[s] Conſult, upon this whole *Article*, Mr. *Evelyn's Sylva.*

SECT. XV.

Of the different Figures of Plants.

Whence the want of a regular Figure in Vegetables.

1. TREES and Herbs keep no Order, and are not figured in the Growth of their Boughs and Branches; becauſe the Sap being reſtrained in the Bark, breaks not forth in the Bodies of Trees, and Stalks of Herbs, till they begin to branch; and when they make an Eruption, they do it caſually, where they find beſt way in the Bark [t]. 'Tis true, ſome Trees are more ſcattered in their Boughs; as the Sallow, Warden, Quince, *&c.* ſome more pyramidal; as the Pear, Orange, Fir, Service, Lime, *&c.* ſome more broad; as the Beech, Hornbeam, *&c.* and the reſt are more indifferent. The *Cauſe* of ſcattering the Boughs, is the haſty breaking forth of the Sap: whence ſuch Trees riſe not in a Body of any height; but branch near the Ground. The *Cauſe* of the pyramidal Form, is the keeping in of the Sap, long before it branch; and the ſpending of it, when it begins to branch, by equal degrees. The ſpreading is cauſed by the riſing of the Sap plentifully, without Expence; and then putting forth ſpeedily at once.

Whence Plants put forth their Leaves in a certain order.

2. There are many Herbs, but no Trees, that ſeem to obſerve ſome Order in putting forth their Leaves; as having Joints, Knuckles, or Stops in their Germination; as July-flowers, Pinks, Fennel, Corn, Reeds, and Canes. The *Cauſe* whereof is, that the Sap aſcending unequally, tires and ſtops by the way. And it ſeems they have ſome Cloſeneſs and Hardneſs in the Stalk; which hinders the Sap from growing up, till it has gathered into a Knot; and ſo is more urged to put forth. And hence they are moſt of them hollow, when the Stalk is dry; as in Fennel, Stubble, and Canes.

Whence the exquiſite Figures of Flowers.

3. All Flowers have exquiſite Figures: and the *Flower-Numbers* are chiefly five, and four. Primroſes, Briar-roſes, ſingle Muſk-roſes, ſingle Pinks, July-flowers, *&c.* have five Leaves: Lilies, the Flower-deluce, Borage, Bugloſs, *&c.* have four Leaves. But ſome have numerous Leaves, tho ſmall; as Marygolds, Trefoil, *&c.* The Sockets, and Supporters of Flowers are figured; as in the five Brethren of the Roſe; the Sockets of July-flowers, *&c.* All Leaves alſo are figured; ſome round, ſome long, none ſquare, and many jagged on the Sides: which ſeldom holds in the Leaves of Flowers. For the jaggedneſs of Pinks and July-flowers ſeems like the Inequality of the Oak, or Vine-leaves; but they ſeldom or never have any ſmall Pearls [u].

SECT.

[t] See Dr. *Sharrock's Hiſtory of the Propagation and Improvement of Vegetables*, Pag. 142.

[u] Conſult Mr. *Ray*, M. *Tournefort*; and the *Philoſophical Botaniſts*, upon this *Article*.

SECT. XVI.

Of the principal Differences in Plants.

Why ſome Plants bloſſom before they have Leaves.

1. SOME few Plants bear Bloſſoms before they have Leaves; as Almonds, Peaches, Cornelians, Black-thorn, *&c.* but moſt have ſome Leaves before they bloſſom; as Apples, Pears, Plumbs, Cherries, *&c.* The *Cauſe* is, that thoſe which yield their Bloſſoms firſt, have either an acute and ſharp Spirit, whence they commonly put forth early in the Spring, and ripen very late; or elſe have an oily Juice; which is apter to put out Flowers than Leaves.

The Cauſe of Evergreens.

2. Some Plants are green all Winter; others caſt their Leaves. The Ever-greens are Holly, Ivy, Box, Fir, Yew, Cypreſs, Juniper, Bays, Roſemary, *&c.* The *Cauſe* of their holding green, is the cloſe and compact Subſtance of their Leaves, and the Pedicles of them. And the *Cauſe* of this again is either the viſcous Juice of the Plant; or its Strength and Heat. Of the firſt ſort is Holly; which is of ſo viſcous a Juice, as to make Bird-lime. The Stalk of Ivy is tough, and not brittle. Fir yields Pitch: Box is a cloſe and heavy Wood; and Yew is a ſtrong and tough Wood. Of the ſecond ſort is Juniper; which is an odoriferous Wood, and makes a fierce Fire. Bays likewiſe is a hot and aromatic Wood; ſo is Roſemary, for a Shrub. The Denſity of the Leaves, appears hence; that they are ſmooth and ſhining: as in Bays, Holly, Ivy, Box, *&c.* or hard and ſpiry. Trial ſhould be made of grafting Roſemary, Bays, and Box, upon a Holly-Stock; becauſe theſe are Plants that grow all the Winter. It were proper to try it alſo with Grafts of other Trees, either Fruit-Trees or wild ones; to ſee whether they will not yield Fruit, or bear Leaves later and longer in the Winter; becauſe the Sap of Holly puts forth moſt in the Winter. Perhaps alſo a Mezereon-Tree grafted upon a Holly, will prove both an earlier and larger Tree.

Some Trees that bear no Flowers yet produce Fruit, & vice verſa.

3. Some Plants have no Flower, and yet bear Fruit: ſome bear Flowers, but no Fruit; and ſome again bear neither Flowers nor Fruit. Moſt of the great Timber-Trees, as Oak, Beech, *&c.* bear no apparent Flowers: ſome few Fruit-Trees; as the Mulberry, Walnut, *&c.* and ſome Shrubs, as Juniper, Holly, *&c.* bear no Flowers. Divers Herbs alſo have Seeds for their Fruit, yet bear no Flowers; as Purſlane, *&c.* Thoſe that bear Flowers and no Fruit are few; as the double Cherry, the Sallow, *&c.* But for the Cherry, 'tis doubtful whether it be not by Art; and if ſo, then Trial ſhould be made, whether Apple, and other Fruit-Trees that bloſſom, may not be doubled. There are ſome few that neither bear Fruit nor Flower; as the Elm, Poplar, Box, *&c.*

Why ſome Plants grow erect, and others creep.

4. Moſt Plants ſhoot ſtill upwards, and ſupport themſelves; whilſt others creep along the Ground; or wind about other Trees or Props, unable to ſupport themſelves; as the Vine, Ivy, Briar, Bryony, Wood-bine, Hop, *&c.*

The

The *Cauſe* is, that all Plants naturally move upwards; but if the Sap riſe too faſt, it makes a ſlender Stalk, which will not ſupport the weight: whence the latter ſort are all haſty growers [v].

SECT. XVII.

Of Compoſts, and Helps for Ground.

1. THE *firſt* and moſt ordinary Help for Ground is Stercoration. Sheep's-dung is one of the beſt; the next is the Dung of Kine; and thirdly that of Horſes; which is held ſomewhat too hot unleſs it be mix'd. That of Pigeons for a Garden, or a ſmall piece of Ground, is excellent. The way of applying the Dung to arable Land, is to ſpread it immediately before Ploughing; ſo as to plough it in: for if ſpread long before, the Sun will draw out much of its Fatneſs. For grazing Ground, the way is to ſpread it ſomewhat late, towards Winter; that the Sun may have leſs power to dry it up. *The uſual kinds of Manure.*

2. The *ſecond* kind of *Compoſt* is, divers kinds of Earth; as (1.) Marle, (2.) Sea-Sand, (3.) Chalk, (4.) Earth upon Earth, (5.) Pond-Earth; and (6.) Mixtures of them. (1.) *Marle* is thought the beſt; as having moſt Fatneſs, and not heating the Ground too much [w]. (2.) The next is *Sea-Sand*; which obtains a particular Virtue from the Salt: for Salt is the firſt Rudiment of Life [x]. (3.) *Chalk* over-heats the Ground a little; and therefore does beſt upon cold Clay, or moiſt Grounds. It is a common Error, to think Chalk helps arable Land; but not grazing Ground. The Error proceeds hence, that after chalking of the Ground, they wear it out by many Crops without reſt; and then indeed it will afterwards bear little Graſs. It were a good Experiment to lay Chalk upon arable Ground a little before Ploughing; and to plough it in as they do Dung: but then it muſt firſt be made friable by Rain or lying. (4.) Earth is a Compoſt to Earth. I knew a great Garden, that had a Field, as it were, poured upon it; and it bore Fruit excellently the firſt Year: for the Surface of the Earth is always the moſt fruitful. And Earth ſo prepared has a double Surface. But ſuch Earth as affords Salt-petre, if procurable without too much Charge, is beſt. The way to haſten the growth of Salt-petre, is to exclude the Sun, and prevent the growth of Vegetables: and therefore to make a large thatch'd Hovel over ſome quantity of Ground; or even to plank the Ground over, will produce Salt-petre. (5.) Pond-Earth, or River-Earth is a very good Compoſt; eſpecially if the Pond have been long uncleaned, and ſo the Water be not too hungry: and I judge it will be yet better, if mix'd with Chalk. *A ſecond kind.*

[v] Many curious Obſervations, for the improvement of this *Article*, are ſupplied by the *French Memoirs*.

[w] See Sir *Hugh Plat's Jewel-Houſe of Art and Nature*, pag. 114, *&c.*

[x] See *Boerhaave's Chemiſtry*, under the *Proceſſes upon Sea-Salt*.

A third Kind. 3. The *third* Help for Ground is procured by means of ſome other Subſtances, tho not merely earthy, having a Virtue to fertilize: wherein Aſhes excel; inſomuch that the Countries about *Ætna* and *Veſuvius*, have a kind of amends made them in the exceeding Fertility of the Soil, for the Miſchief done them by the Eruptions: which Fertility is cauſed by the Aſhes ſcatter'd over the Ground. Soot alſo, tho thin ſpread in a Field or Garden, is found a very good Compoſt. Salt is too coſtly: it has been tried, that mix'd with Seed-Corn, and ſown together, it proves ſerviceable; and I am of Opinion, that powder'd Chalk, mix'd with Seed-Corn, would do good; perhaps as much as chalking the Ground all over. As to the ſteeping of Seeds in ſeveral Mixtures with Water, to give them Vigour, and watering Grounds with Compoſt-water, we have ſpoke thereto already [y].

A fourth Kind. 4. The *fourth* Help is ſuffering Vegetables to die into, and ſo fatten the Ground; as the Stubble of Corn, eſpecially of Peaſe. Brakes caſt upon the Ground in the beginning of Winter, will make it very fruitful. It were proper alſo to try whether Leaves ſwept together, and mix'd with ſome Chalk and Dung, to give them more Heart, would not make a good Compoſt; for there is nothing waſted ſo much as the Leaves of Trees: and as they lie ſcatter'd, and without Mixture, they rather make the Ground ſour than otherwiſe [z].

A fifth Kind. 5. The *fifth* Help for Ground is Heat and Warmth. It has been anciently practis'd to burn Heath, Ling and Sedge, with the advantage of the Wind, upon the Ground. We find that the warmth of Walls and Enclofures is an Amendment: ſo is lying open to the South; and the folding of Sheep; as well by their Warmth, as their Compoſt: and perhaps the covering of Ground with Brakes in the beginning of the Winter, may help by means of the Warmth. Nay, ſome ſuſpect, that the uſual way of gathering Flints in flinty Ground, and laying them on Heaps, is no good Huſbandry; becauſe they would keep the Ground warm.

A ſixth Kind. 6. The *ſixth* Help for Ground is watering; which may be done two ways; the one by letting in and ſhutting out the Water at ſeaſonable Times: for Water let in at ſome times, if it ſtay not too long, does good; but at others, and if it ſtay too long, hurt. And this ſerves only for Meadows, adjacent to a River. The other way is, to bring Water from ſome high Grounds, where there are Springs, into the lower; carrying it in long Furrows; and from theſe Furrows drawing it tranſverſe, to ſpread the Water: which makes an excellent improvement both for Corn and Graſs: tho the Expedient proves the richer, if theſe hanging Grounds be fruitful; becauſe the Water thus waſhes down ſome of the Fatneſs of the Earth. Generally where there are great Over-flows in Fens, or the like, the drowning of them in Winter makes the following Summer more fruitful: as keeping the Ground warm, and nouriſhing it. But the Fenmen hold, that the Sewers may be kept ſo as to continue the Water too long in the Spring, till the Weeds, and Sedge be grown up; becauſe then the

[y] See above *Sect.* R.

[z] Has the Experiment of converting Leaves into Manure been fully tried?

the Ground, like a Wood, will keep out the Sun; and ſo continue the Wet, and never graze well that Year [a].

SECT. XVIII.

Of the Relations between Plants and inanimate Bodies.

The two grand Differences betwixt animate and inanimate Bodies.

1. ALL Bodies have Spirits, and pneumatical Parts: but the principal Differences between animate and inanimate Bodies are two. The *firſt*, that the Spirits of animated Things are all contained within themſelves, and branched in Veins, and ſecret Canals, as the Blood is: and in living Creatures, the Spirits have not only Branches, but certain Cells or Seats, where the principal Spirits reſide, and whereto the reſt reſort: but the Spirits in Things inanimate are ſhut up, and cut off by the tangible Parts, and are impervious one to another, as Air in Snow. The *ſecond* grand Difference is, that the Spirits of animate Bodies are in ſome degree kindled, or have a fine commixture of Flame, and an aerial Subſtance: but inanimate Bodies have not their Spirits inflamed, or kindled. And this Difference conſiſts not in the heat or coolneſs of the Spirits; for *Naptha*, Cloves, and other Spices, have exceeding hot Spirits; much hotter than Oil, Wax, *&c.* but are not inflamed. And when any of theſe weak and temperate Bodies come to be inflamed, they gather a much greater Heat than others uninflamed; beſides their Light and Motion [b].

The ſecondary Differences.

2. The ſecondary Differences proceeding from theſe two radical ones, are, *firſt*, that Plants are figured and determinate; which inanimate Bodies are not: for as far as the Spirit is able to ſpread and continue itſelf, ſo far goes the Figure, and is then determined. *Secondly*, Plants are nouriſhed; but inanimate Bodies are not: the latter have an Accretion, but no Alimentation. *Thirdly*, Plants have a Period of Life; which inanimate Bodies have not. And, *Fourthly*, they have a Succeſſion and Propagation of their Kind; which inanimate Bodies have not.

The Differences betwixt Plants and Foſſils.

3. The Differences between Plants and Foſſils, beſides thoſe already mention'd, are theſe. (1.) Metals are more durable than Plants: (2.) More ſolid and hard: (3.) They are wholly ſubterraneous; whereas Plants are part above Ground and part below. Few Creatures participate both of the Nature of Plants and Metals. Coral is one of the neareſt; and another is Vitriol; which is apteſt to ſprout with Moiſture.

The Affinity betwixt Plants and Mould.

4. There is another particular Affinity between Plants and Mouldineſs, or Putrefaction; for all Putrefaction, if not diſſolved in Arefaction, will determine into Plants, or living Creatures, bred by Putrefaction: Moſs, Muſhrooms, Agarick, *&c.* appear to be but the Mouldineſs of the Ground, Walls, Trees and the like. Fleſh, Fiſh, Plants, aud many other Things,

[a] Let the other kinds of Amendment be here enumerated. See Mr. *Evelyn's Terra*, and the *Philoſophical Tranſactions*. See alſo Sir *Hugh Plat's Jewel-Houſe of Art and Nature*.

[b] See more to this purpoſe in the Author's *Hiſtory of Life and Death*, *ſub finem*.

after Mouldineſs, or Corruption, produce Worms. Theſe Putrefactions, notwithſtanding their Affinity to Plants, have this Difference from them; that they are without Succeſſion or Propagation; tho they are nouriſhed, have a period of Life, and likewiſe ſome Figure. A cut Citron, being left in a cloſe Room, for three ſummer Months, there were grown out of the Pith, Tufts of Hairs an Inch long, with little black Heads, as if they would have been ſome Herb [c].

SECT. XIX.

Of the Relations between Plants and Animals.

The radical and ſecondary Differences betwixt Plants and Animals.

1. THE Affinities and Differences between Plants and Animals are theſe. They have both of them Spirits continued, branched, and inflamed. But, (1.) in living Creatures, the Spirits have a Cell, or Seat; which Plants have not. And, (2.) the Spirits of living Creatures hold more Flame, than the Spirits of Plants. And theſe two are the radical Differences [d]. The ſecondary Differences are as follow. (1.) Plants are fix'd to the Earth; whereas Animals are ſevered from it. (2.) Animals have local Motion; which Plants have not. (3.) Animals are nouriſhed from their upper Parts, the Mouth chiefly; but Plants from below. (4.) Plants have their Seed and ſeminal Parts uppermoſt; Animals lowermoſt: whence it was philoſophically ſaid, that Man is like an inverted Plant: for the Root in Plants is as the Head in Animals. (5.) Animals have a more exact Figure than Plants. (6.) They have a greater diverſity of Organs within their Bodies, and internal Figures, than Plants. (7.) They have Senſe; which Plants have not. (8.) They have voluntary Motion; which Plants have not.

A Male and Female kind in Plants.

2. The different Sexes in Plants, are often diſtinguiſh'd by Name: as Male-piony, Female-piony; Male-roſemary, Female-roſemary; He-holly, She-holly, *&c.* but Generation by Copulation extends not to Vegetables. But perhaps a *Binary* of ſtronger and weaker, like Maſculine and Feminine, holds in all living Bodies: tho 'tis ſometimes confounded; as in Creatures bred of Putrefaction, where no Marks of Diſtinction appear: and 'tis ſometimes doubled, as in Hermaphrodites: but generally there are degrees of ſtrength in all Species. The Intermediates between Plants and Animals, are chiefly

[c] Here ſeems to be a conſiderable Foundation laid for the Natural Hiſtory of *Mouldineſs*; which the Microſcope ſhews to be a kind of Wood, or Grove of Plants. But this requires to be proſecuted, in Fruits, fermented Liquors, and all Vegetable, Animal, and many Mineral Subjects.

[d] This may deſerve a very ſtrict Examination. See the Author's *Hiſtory of Life and Death*; and compare the Doctrine there delivered to this purpoſe, with Mr. *Boyle*'s Experiments upon *Plants* and *Air*.

chiefly fix'd, and have no local Motion of removal, tho they have Motion in their Parts; as Oysters, Cockles, and the like [e].

SECT. XX.

Miscellaneous Experiments and Observations upon the Subject.

1. SCARCE any Vegetables have Branches without Leaves, except Coral. But in the Deserts of S. *Macario* in *Egypt*, is a long, leafless, brown Plant, and branched like Coral, only closing at the top; which being set in Water within Doors, spreads and displays strangely. The Natives have a superstitious Belief that it helps Delivery. *Plants without Leaves.*

2. The *Indian* Fig bows its Branches down so low in one Year, as to take Root again; and thus multiplies from Root to Root, making a kind of Wood. This may proceed from the Plenty of the Sap, and the Softness of the Stalk; which makes the Bough, being over-laden, and not strongly upheld, weigh down. Its Leaves are as broad as a little Target; but the Fruit no bigger than Beans: for the continual Shade increases the Leaves, but stints the Fruit; which nevertheless is of a pleasant Taste. And this proceeds from the suppleness and gentleness of the Juice of the Plant; which also makes the Boughs flexible. *The Indian Fig growing from its own Branches.*

3. Perhaps in some Plants, the Sap rises so fast, as to have no leisure to divide into many Leaves; or put forth much Stalk to the Fruit. With us Trees generally have small Leaves in Comparison. The Fig-Tree has the largest; and next to that the Vine, Mulberry, and Sycamore: the least are those of the Willow, Birch, and Thorn. But there are Plants with far greater Leaves than any Tree; as the Bur, Gourd, Cucumber, Colewort, *&c.* The *Cause* is, the hasty and plentiful rising of the Sap. *Whence large and small Leaves in Plants.*

4. There are three Things in use for sweetness; *Sugar*, *Honey*, and *Manna*. *Sugar* was scarce known to the Ancients, and little used [f]. 'Tis found in Canes. *Honey* is made, or gathered by the Bee; but I have heard, that the Labour of the Bee is about the Wax; and that in the beginning of *May*, Honey-Combs have been found empty of Honey; and within a Fortnight, when the sweet Dews fall, fill'd like a Cellar. 'Tis probable that the Sap and Tears of some Trees are sweet [g]. Perhaps also *some sweet Juices, fit for many Uses, may be boiled out of Fruits, to the thickness of Honey or Sugar.* Let the means be enquired into. The likeliest Matters are Raisins, Figs, Currans, *&c* [h]. *Whether a Saccharine Substance be not obtainable from certain Vegetables.*

5. Some

[e] There are several Particulars relating to this Subject, collected together in *Boerhaave*'s *Chemistry*.

[f] See the *Article* SUGAR.

[g] As the *Birch*, the *Sycamore*, &c. See the *Philosophical Transactions*.

[h] To these may be added malted Corn, Nuts, Pulse, and every other Vegetable capable of being malted. What is the best way of reducing the sweet Substance of these Commodities to an actual Sugar? Let the common Method of making *Sugar* from the Raw Juice be tried. See the *Article* SUGAR. Consider of Plantations of Hips, Parsnips, Fennel, Maple, and any other cheap Vegetable, that yields a saccharine Juice.

The Vegetables that afford Clothing, &c.

5. Some Plants are uſed for Raiment; as Hemp, Flax, Cotton, Nettles, and growing Silk: they alſo make Cables of the Bark of the Lime-Tree. 'Tis the Stalk that commonly makes the matter of the Thread; and ſometimes the Down that grows a-top [i].

Three different Kinds of Roots.

6. Some Plants have a moſſy or downy Root; and ſome have a number of Threads, like Beards; as Mandrakes, whereof Impoſtors make an ugly Image, giving it a Face at the top, and leaving theſe Strings to make a broad Beard down to the Foot. There is alſo a kind of Nard in *Crete*, having a hairy Root. So that there are bulbous Roots, fibrous Roots, and hairy Roots. In the *bulbous*, perhaps, the Sap haſtens moſt to the Air and Sun: but in the *fibrous*, delights more in the Earth; the hairy being a middle Nature between both; that beſides ſhooting both upwards and downwards, puts forth in a round.

Some Tears of Trees combed from the Beards of Goats.

7. Some Tears of Trees are combed from the Beards of Goats: for when the Goats bite and crop, eſpecially in the Morning Dews, the Tear comes out and hangs upon their Beards. Of this ſort is a kind of *Labdanum*.

The way of tranſpoſing exotick Roots.

8. In order to remove foreign Roots to a great Diſtance, let them be cloſe packed in earthen Veſſels. But if the Veſſels be not very large, make ſome Holes in the bottom; to give refreſhment to the Roots, which otherwiſe will decay and ſuffocate.

Uncommon Properties of the ancient Cinnamon.

9. The ancient *Cinnamon* was, of all Plants while it grew, the dryeſt [k]; and the Things known to comfort other Plants, made this more ſteril; for in Showers it proſper'd worſt: it alſo grew among Buſhes of other Kinds, where Plants do not commonly thrive: neither did it love the Sun. There might be one *Cauſe* of all theſe Effects; *viz.* the ſparing Nouriſhment it required. *Quære*, how far *Caſſia*, which is now the ſubſtitute for Cinnamon, participates of theſe Properties [l]?

Large Vines known to the Ancients.

10. There were anciently Vines of much larger Bodies than we are acquainted with; ſo that Cups, and an Image of *Jupiter* has been made of them. But perhaps theſe were Wild-Vines; the Vines uſed for Wine, being ſo often cut, dug and dreſs'd, that their Sap goes into the Grapes; whence the Stalk cannot increaſe much in Bulk [m]. The Wood of Vines is very durable, without rotting. And tho no Tree, while green, has ſuch brittle Twigs; yet the Wood dried is extremely tough: and was uſed by the *Roman* Captains for their Cudgels.

Vines running along the Ground.

11. 'Tis reported, that in ſome places, Vines are ſuffer'd to grow like Herbs, ſpreading upon the Ground; and that the Grapes of thoſe Vines are very

[i] All the Vegetables ſhould be enumerated that will bear the Hatchel.

[k] The great apparent dryneſs of the common *Cinnamon* has perhaps given occaſion to ſuſpect that this fine Aromatic cannot, in *England*, be diſtilled, for its Oil, to Advantage. But thoſe who are skilful in the drawing of eſſential Oils, may find the contrary upon Trial.

[l] Wherein did the ancient *Cinnamon* differ from the modern? *Caſſia Lignea* differs conſiderably from the preſent Cinnamon; particularly in abounding with a mucilaginous part; which *Cinnamon* is without.

[m] Is there not alſo an eſſential difference betwixt the two Species?

very large. It were proper to try whether Plants uſually ſuſtain'd by Props, will not bear larger Leaves and Fruits, if laid along the Ground; as Hops, Ivy, Woodbine, *&c.*

12. It is *credibly reported*, that to lay good ſtore of Grape-ſtones about the Root of a Vine, will make the Vine come earlier, and proſper better [n]. This may be tried with other Kernels, laid about the Root of a Plant of the ſame kind; as Figs, Apples, *&c.* The *Cauſe* may be, that the Kernels attract the Juices fit to nouriſh the Tree, as theſe would be Trees themſelves, if there were no Root; but the Root, being of greater Strength, draws the Nouriſhment from them. *The improvement of Vines.*

13. To preſerve Quinces, Apples, *&c.* plunge them in Honey; but becauſe Honey may give them an over-luſcious Taſte, try Sugar, or Syrup of Wine, boil'd to a due height [o]. This ſhould likewiſe be tried in Oranges, Lemmons, and Pomegranates. The Conſervation of Fruit ſhould alſo be tried in Veſſels fill'd with fine Sand, or powder of Chalk; or in Flower; the Duſt of Oak-wood, *&c* [p]. Fruits intended for long keeping, muſt be gathered before they are full ripe; and in a fair dry Day, towards Noon; the Wind blowing not South; the Moon being under the Earth; and in her Decreaſe. *The means of preſerving Fruit.*

14. If Grapes be ſuſpended in an empty Veſſel well ſtopped, and ſet in a dry place, 'tis ſaid they will keep long; but better, 'tis thought, in a Veſſel half full of Wine; provided the Grapes do not touch the Wine. 'Tis reported that preſerving the Stalk, helps to preſerve the Grape; eſpecially if ſome of the Stock be took off along with the Branches; or the Stalk be put into the Pith of Elder; the Elder not touching the Fruit [q]. *To preſerve Grapes.*

15. Some Herbs and Plants are good to eat raw; as Lettuce, Endive, Purſlane, Creſſes, Cucumbers, Radiſh, *&c.* others only after they are boil'd; as Parſley, Clary, Aſparagus, *&c.* but many Herbs are not eſculent at all; as Wormwood, Graſs, Centaury, Hyſſop, Lavender, *&c.* The Herbs that are not eſculent, want two Properties wherein Nouriſhment conſiſts; *viz.* Fatneſs and Sweetneſs [r]; and have bitter and overſtrong Taſtes, or a Juice ſo crude as not to be ripen'd to the degree of Nouriſhment. Herbs and Plants that are eſculent when raw, have a Fatneſs, or Sweetneſs; ſuch are Onions, Lettuce, *&c.* But it muſt be ſuch a Fatneſs as is not too groſs, *What Plants are eſculent.*

[n] Does it make the Vine proſper better than any other Manure?

[o] This Syrup of Wine, I conceive, is made by boiling Wine to the Conſiſtence of a Syrup; either with or without the addition of Sugar. The Remains after the Diſtillation of Brandy may be thus treated to Advantage. But let the Operation be perform'd *in Balneo Mariæ*; whereby an excellent Preparation will be obtained; of Service both in Food and Phyſick.

[p] Theſe are ſerviceable Methods of preſerving either Fruits or Flowers.

[q] There are numerous Expedients of this Kind. The way in *France* is to hang the Grapes in a dry Room upon Lines, ſo that no two Bunches may touch: and thus they keep them long moiſt, and tolerably freſh. This Method ſeems taken from that other of preſerving them upon the Vine; where they will hang long, if the Vine be houſed, or ſecured from the injuries of the Weather.

[r] Let this be examined in the inductive Method, to ſee if an *Axiom* can be form'd upon it.

groſs, and overloading to the Stomach: for Parſnips and Leeks have Fatneſs; but it is too groſs and heavy without boiling. This Fatneſs muſt alſo be in a Subſtance ſomewhat tender; for Wheat, Barley, Artichoakes, *&c.* are no good Nouriſhment, till they have paſs'd the Fire; which ripens and makes them ſoft, tender, and eſculent. Radiſh, Tarragon, and the like, are rather for Sauce than Nouriſhment. And ſome Herbs, which are not eſculent, are, however, potulent; as Hops, Broom, *&c.* *Quære*, What Herbs are good for Drink, beſides theſe two? For it may eaſe the Charge of Brewing, if they make Beer require leſs Malt, or render it more durable [r].

What parts of Plants are nutrimental.

16. The parts of Plants fit to nouriſh the Body are Seeds, Roots, and Fruits; but chiefly Seeds and Roots. Leaves, Flowers, and Stalks, yield little or no Nouriſhment. The *Cauſe* is, that Roots, Seeds, and Fruits have more of the oily Subſtance; and Leaves, Flowers and Stalks, more of the watry. Again, they are more concocted; for the Root which always continues in the Earth, is ſtill concocted by the Earth; and Fruits, and Grains, are half a Year, or more, in concocting; whereas Leaves are out and perfect in a Month [t].

Why ſome Plants are ſtronger in the Seed, and others in the Root.

17. Plants are uſually ſtronger in their Seed, both to the Taſte and Smell, than in the Leaf and Root. The *Cauſe* is, that in Plants not of a fierce and eager Spirit, the Virtue is increaſed by Concoction and Maturation, which is always moſt in the Seed; but in Plants of a fierce and eager Spirit, they are ſtronger, whilſt the Spirit is incloſed in the Root: and the Spirits do but weaken and diſſipate when they come to the Air and Sun; as we find in Onions, Garlick, Dragon, *&c.* Nay, ſome Plants have their Roots very hot and aromatic, yet their Seeds rather inſipid; as Ginger: the Heat of thoſe Plants being very diſſipable, which under the Earth is kept in; but exhales when it comes to the Air [u].

Fruits divided into watry, oily, and ſweet.

18. The Juices of Fruits are either watry or oily. Among the watry come all the Fruits that afford potable Liquors; as the Grape, the Apple, the Pear, the Cherry, *&c.* And there are ſome others, which, tho not uſed for Drink, yet appear of the ſame Nature; as Plumbs, Services, Mulberries, Rasberries, Oranges, Lemmons, *&c.* and thoſe Juices that are too fleſhy to make Drink by Expreſſion, may do it by the admixture of Water [v]. Perhaps Hips, and Briar-berries would do the like [w]. The Fruits that

[r] The Brewers are ſaid to uſe Wormwood, Gentian, *&c.* inſtead of Hops; Treacle inſtead of Malt; and, to give an additional Strength, *Grains of Paradiſe.*

[t] This Matter requires a farther Enquiry, and Verification.

[u] See the *Proceſſes relating to Vegetables*, in *Boerhaave's Chemiſtry.*

[v] *Poculaq; admiſtis imitantur vitea ſorbis.*

[w] Theſe are Intimations of conſiderable Service. All kinds of Plumbs, tho' ever ſo hard and fleſhy; being bruiſed and mixed with Water, ferment kindly; and with Skill make tolerable Wines. Hips are an excellent Fruit for this purpoſe: but Blackberries make a coarſe Wine; tho a good Brandy. Certainly it were practicable to have Plantations of ſuch Fruit-Trees in *England*, as ſhould afford us *Wines*, equal in Goodneſs to thoſe of foreign Growth. Some have tolerable Succeſs with the *Burgundy* Grape; ſome with the *Morelli* Cherry; ſome with

that have oily Juices, are Olives, Almonds, Nuts, Pine-apples, *&c.* and their Juices are all inflammable [x]. Obſerve likewiſe, that ſome of the watry Juices, after Fermentation, will burn and flame; as Wine. There is a third kind of Fruit that is ſweet, without either ſharpneſs or oilineſs: ſuch as the Fig, the Date [y], *&c.*

19. It has been noted, that moſt Trees, eſpecially thoſe that bear *Maſt*, are fruitful but once in two Years: the *Cauſe* is, the Expence of Sap; for many Orchard Trees, well cultured, will bear ſeveral Years together [z]. *Why Maſt-Trees bear but once in two Years.*

20. No Tree bears ſo many baſtard Fruits as the Oak: for beſides the Acorn, it bears Galls, Oak-Apples, certain Oak-Nuts, which are inflammable; and certain Oak-Berries, ſticking cloſe to the body of the Tree without Stalk. It bears alſo Miſſeltoe, tho rarely [a]. The *Cauſe* of this may be, the cloſeneſs and ſolidity of the Wood, and Pith of the Oak; whence different Juices make different Eruptions. And therefore, to produce Super-plants, we muſt give the Sap a plentiful Riſe, and a hard Iſſue [b]. *Why the Oak bears many baſtard Fruits.*

21. There are two Excreſcences of Trees; both of them growing in the Nature of Muſhrooms: the *one* the *Romans* call'd *Boletus*; which grows upon the Roots of Oaks, and was a Dainty of their Table; the *other* is medicinal, and call'd *Agarick*, which grows upon the Oak; and is alſo affirmed to grow at the Root. I conceive that many Excreſcences of Trees grow chiefly where the Tree is dead, or faded: the Sap there corrupting into ſome preternatural Subſtance [c]. *Two Muſhroom-like Excreſcencies of Trees.*

22. Moſt Trees bear beſt on the lower Boughs; as Oaks, Figs, Walnuts, Pears, *&c* [d]. but ſome bear beſt on the top; as Crabs, *&c.* Thoſe that bear beſt below, are ſuch as Shade befriends; for generally Fruit-Trees bear beſt below: becauſe the Sap has but a ſhort way to go [e]. But Shade hinders the lower Boughs; except in ſuch Trees as delight in Shade, or bear it well. Thoſe therefore are either ſtrong Trees, as the Oak; or have large Leaves, as the Walnut and Fig; or elſe they grow *pyramidal* as the Pear. But if they require much Sun, they bear beſt on the top; as in Crabs, Apples, Plumbs, *&c.* *The Cauſe of Trees bearing ſome better above, and ſome beſt below.*

with the white Curran; ſome with the white Eder, *&c.* And, perhaps, by a proper Expedient our better kinds of Cyder are convertible into Wines, not to be diſtinguiſhed from the beſt Wines of *France* or *Portugal*, whether Red or White. See Mr. *Auſten's Treatiſe of Fruit-Trees*, the *Vinetum Britannicum*, *Boerhaave's Chemiſtry*, &c.

[x] The Plants that afford Oil ſhould be diligently ſought after; on account of their great Utility. Conſider of Beech-Maſt, the Sun-Flower-Seed, Muſtard-Seed, *&c.* for this purpoſe.

[y] Theſe alſo ſhould be enumerated; as being not only Food, but capable of affording Drink by Fermentation.

[z] Is this Cauſe juſtly aſſigned?

[a] See above *Sect.* X. 18.

[b] If the *Cauſe* be juſt; ſo will the *Rule*: and obſerve, in general, that the Diſcovery of *Cauſes* is the finding of *Rules*. This has been intimated more than once already; but the importance of the thing may allow of a Repetition.

[c] This Subject is touched above: See Sect. X. See alſo more to the ſame purpoſe in the *Philoſophical Tranſactions*, N° 330.

[d] This ſhould ſeem to be meant of Wall-Trees, rather than Standards.

[e] Is there not ſome more latent *Cauſe* of the Effect? See the *French Memoirs*, and *Philoſophical Tranſactions*.

Why ſome Trees bear beſt when old.

23. Some Trees bear beſt when they begin to be old; as Almonds, Pears, Vines, and all the Trees that yield Maſt. The *Cauſe* is, that all Trees bearing Maſt, have an oily Fruit; and young Trees a more watery Juice, and leſs concocted: and of this kind is the Almond. The Pear likewiſe, tho it be not oily, yet requires much Sap, and well concocted; for 'tis a heavy and ſolid Fruit; much more ſo than Apples, Plumbs, *&c.* The Vine bears more Grapes when it is young; but Grapes that make the beſt Wines, when it is old: the Juice being then better concocted. And we ſee Wine is inflammable; ſo that it has a kind of Oilineſs: but moſt Trees bear beſt when young.

Whence milky Juices in Plants.

24. Some Plants ouze out a Milk when cut; as Figs, Sow-thiſtles, Spurge, *&c.* The *Cauſe* may be, a tendency to Putrefaction: for theſe are all acrimonious; tho one would expect them mild. If you write upon Paper with the Milk of the Fig-tree, the Letters will remain inviſible till the Paper be held to the Fire, and then they grow brown; which ſhews the Juice to be ſharp or fretting [e]. Lettuce is thought poiſonous, when ſo old as to have Milk; Spurge is a kind of Poiſon in itſelf; and Sow-thiſtles, tho Rabbits eat them, yet Sheep and Cattle will not: beſides, the Milk thereof rubbed upon Warts, ſoon wears them away; which ſhews the Milk to be corroſive. Wheat alſo, and other Corn, if taken from the Ground before they ſprout, are full of Milk; and *the beginning of Germination is always a kind of Putrefaction* [f]. *Euphorbium* alſo contains a Milk, tho not very white, but of a great Acrimony; and Celandine a yellow acrimonious Milk, that cleanſes the Eyes, and is good in Cataracts [g].

Few red Juices in Plants.

25. There is ſcarce a Plant that yields a red Juice in the Blade or Ear, except that which affords the *Sanguis Draconis*; and grows chiefly in the Iſland *Socotra*. The Herb *Amaranthus*, indeed, is red all over; and Braſil is red in the Wood: ſo is red Sanders. The *Sanguis Draconis* Tree grows in the Form of a Sugar-loaf. Perhaps the Sap of that Plant concocts in the Body of the Tree. For Grapes and Pomegranates are red in the Juice [h], but green in the Tear: and this makes the *Sanguis Draconis* Tree leſs towards the Top; becauſe the Juice does not riſe quick; and is, beſides, very aſtringent, and therefore of ſlow Motion.

Sweet Moſs.

26. 'Tis ſaid, that ſweet Moſs ſometimes grows upon the Poplar as well as the Apple-tree; and yet the Poplar-tree has a ſmooth Bark, and little Moſs. The Moſs of the *Larix* Tree, alſo burns ſweet, and ſparkles in the burning. Enquire about the Moſſes of odoriferous Trees, as Cedar, Cypreſs, Lignum-Aloes, *&c.*

Whence Hemlock procures an eaſy Death.

27. Hemlock is noted for procuring the leaſt painful Death; and therefore, out of humanity, was uſed at *Athens*, for executing capital Offenders. The Poiſon of the Aſp has ſome affinity with this Plant. The *Cauſe* is, that the Torment of Death being chiefly produced by the ſtruggle of the Spirits;

[e] On what Principle is the Conſequence founded?
[f] Obſerve it particularly in Malting, where the Operation paſſes wholly under the Eye.
[g] Compare this with the Account given of Vegetables in *Boerhaave's Chemiſtry*.
[h] That is, upon Preſſure.

Spirits; the cold Vapours of theſe quench the Spirits by degrees; as in the Death of an extreme old Man. I conceive it leſs painful than *Opium*; becauſe *Opium* has hot Parts intermixed with it [i].

28. Some Fruits are ſweet before they are ripe; as Myrobalans, Fennel-ſeed, *&c.* ſome never ripen to be ſweet; as Tamarinds, Barberries, Sloes, *&c.* The *Cauſe* is, that the former have much ſubtile Heat, which gives early Sweetneſs; whilſt the latter have a cold and acid Juice, which no heat of the Sun can ſweeten. But the Myrobalan has Parts of contrary Natures; being both ſweet and aſtringent [k]. *Why ſome Fruits ripen ſweet, and others not.*

29. Few Herbs have a ſalt Taſte; but the Blood of living Creatures is ſaline. The *Cauſe* may be hence, that Salt, tho the Rudiment of Life, yet the original Taſte does not remain in Plants; for we have them bitter, ſour, ſweet, biting, but ſeldom ſalt: whilſt, in Animals, all thoſe high Taſtes may happen to be in the Humours, but ſeldom in the Fleſh, or Subſtance; this being of a more oily Nature, which is not very ſuſceptible of ſuch Taſtes. The Saltneſs of Blood is but a light and ſecret Saltneſs: and even among Plants, ſome participate of Saltneſs; as Sea-weed, Samphire, Scurvy-graſs, *&c.* 'Tis certain, that out of the Aſhes of all Plants a Salt is extracted for medicinal Uſe [l]. *Why ſome Plants have a ſaline Taſte.*

30. Barley being ſteeped three Days in Water, then drained and turned upon a dry Floor, will ſprout half an Inch long; and if let alone without turning, it will ſhoot much more, till the heart be out. Wheat does the ſame. Try it alſo with Peaſe and Beans [m]. This Experiment ſhould be driven farther: for it appears already, that the Earth is not neceſſary to the firſt ſprouting of Plants; and Roſe-buds ſet in Water will blow: therefore try whether the Sprouts of ſuch Grains may not be raiſed to an Herb, or Flower, with Water only, or ſome ſmall Commixture of Earth; for if they may, it ſhould ſeem they will grow much faſter in Water than in Earth: the Nouriſhment being eaſier drawn out of Water, than out of Earth. Try the ſame Experiment with Roots as well as Grains: for example, ſteep a Turnip a-while, then dry it, and ſee whether it will ſprout [n]. *The Experiment of Malting to be extended.*

31. Malt in the drenching will ſwell, ſo as, after ſprouting and drying upon the Kiln, to gain at leaſt a Buſhel in eight; yet the Sprouts are rubbed *The Enquiry for introducing Sweetneſs into Bodies recommended.*

[i] Tho the Deſcription given of the ancient Hemlock by *Dioſcorides*, may ſeem to agree with ours; perhaps the two Plants differ greatly in Efficacy. 'Tis ſaid that ſeveral have eaten of our Hemlock without any ill Effect. What affinity has the *Oenanthe Cicutæ facie* with the ancient Hemlock? See *Wepfer* upon the Subject.

[k] Let a nearer Approximation be made to the *Cauſe*.

[l] See the Proceſſes upon Vegetables in *Boerhaave's Chemiſtry*.

[m] They do the ſame.

[n] Here is a noble Direction given for the Application of the firſt part of the common Proceſs of Malting, to other vegetable Subjects: and how far this Experiment may be carried, and to what Advantage, ſeems little apprehended. Is it not applicable to Nuts, Pulſe, and Roots, as well as to all ſorts of Grain, even Rice, Millet, *&c*? See, in the *Philoſophical Tranſactions*, a Method of Malting that hard and gummy Subſtance, *Indian Wheat*, by ſuffering it firſt to ſprout in the Ground; then drying it upon the Kiln. *Lowth. Abridg.* Vol. II. pag. 630—634, or *Numb.* 142.

rubbed off; and there will be a Buſhel of Duſt, beſides the Malt. This, I ſuppoſe, happens not only from the looſe lying of the Parts, but from ſome addition of Subſtance, drawn from the Water in which it was ſteeped [o]. Malt acquires a Sweetneſs in the Operation; as appears yet more in the Wort. *The Edulcoration of things ſhould be tried to the full*; as tending to Nouriſhment [p]: and the making of things inalimental, to become alimental, may be of great profit, in producing new kinds of Proviſion [q].

Why the Skin of the Onion riſes.

32. Moſt Seeds in growing leave their Huſk, or Rind, about the Root: but the Onion carrys it up; whence it appears like a Cap on the Top of the young Onion. The *Cauſe* may be, that its Skin, or Huſk, is not eaſy to break; as we ſee, in peeling of Onions, the Skin is a clinging Subſtance.

Whence ſome Plants are curled.

33. Plants that have curled Leaves, abound with Moiſture; which comes ſo faſt on, that they cannot ſpread themſelves plain, but muſt needs collect together. The weakeſt kind of Curling is Roughneſs; as in Clary and Burr: the ſecond is curling on the Sides; as in Lettuce, and young Cabbage: and the third is folding into an Head; as in Cabbage, full grown, and Cabbage-lettuce.

Fir and Pine ſparkle in breaking.

34. 'Tis ſaid, that Fir and Pine, eſpecially if old and putrefied, tho they ſhine not, as ſome rotten Woods do; yet, in ſudden breaking, will ſparkle like hard Sugar.

Why ſome Trees ſtrike deep Roots.

35. Some Roots of Trees ſtrike deep into the Ground; as the Oak, Pine, Fir, *&c.* ſome ſpread more towards the Surface; as the Aſh, Cypreſs, Olive, *&c.* The *Cauſe* of this may be, that ſuch Trees as love the Sun, unwillingly deſcend far into the Earth, and therefore commonly ſhoot up much; for, their Deſire of approach to the Sun, makes them ſpread the leſs in their Body. And the ſame Reaſon, to avoid Receſs from the Sun, makes them ſpread the more under Ground. And we ſee that ſome Trees, planted too deep in the Ground, to approach the Sun forſake their firſt Root, and put out another nearer the Surface of the Earth. We ſee alſo, that the Olive is full of an oily Juice; the Aſh makes the beſt Fire, and the Cypreſs is a hot Tree; but Oak loves the Earth, and therefore grows ſlowly. Pine, and Fir likewiſe, have ſo much Heat in themſelves, that they the leſs require the Sun. There are Herbs alſo, that have the ſame Difference: thus the *Morſus Diaboli* ſtrikes its Root down ſo low, that it cannot be plucked up without breaking [r].

A Branch growing that was bare at the Bottom.

36. A Branch of a Tree being unbarked at the Bottom, and ſo ſet in the Ground, has grown; even in ſuch Branches as would not have grown if ſet with

[o] Malſters have a Trick of Over-malting their Barley, in order to make it meaſure well: but what additional *Weight* can they give it? or does it naturally acquire any in the Making?

[p] See above, § 18.

[q] Here is a large Field of Enquiry opened, that reaches to the Subjects both of the Vegetable and Animal Kingdom. The making of Malt and Sugar may ſerve as capital Inſtances of the kind, in Vegetable Matters; and, in Animal ones, the Method of converting ſolid Bones into good Nouriſhment, is an Experiment by no Means attended to as it deſerves.

[r] Cannot a nearer Approximation be here made to the *Cauſe*?

with the Bark on: and yet a Tree pared round in the Body above ground, will die. The *Cauſe* may be, that the unbarked Part draws the Nouriſhment beſt; but the Bark continues it only [r].

The Nature and Uſe of the Reed, or Cane.

37. The Reed, or Cane, is a ſucculent Plant, that grows only in Water: 'tis hollow; knuckled both Stalk and Root; and being dry, becomes more hard and brittle than other Wood: it puts forth no Boughs, tho many Stalks from one Root. It differs greatly in Size; the ſmalleſt being fit for thatching Houſes, and ſtopping the Chinks of Ships better than Glew, or Pitch. The ſecond Size is uſed for Angle-rods, and Staves; and in *China*, for beating Offenders upon the Thighs. The different Kinds of them are, the common Reed, the *Caſſia Fiſtularis*, and the Sugar-cane [s]. Of all Plants, it bows the eaſieſt, and riſes again. It ſeems, that of Plants nouriſhed with a Mixture of Earth and Water, it draws moſt Nouriſhment from Water; which makes it the ſmootheſt of all others in Bark, and the holloweſt in Body [t].

Different Juices in Vegetables.

38. The Sap of Trees is of different Natures: ſome more watery and clear, as that of the Vine, Birch, Pear, *&c.* ſome thick, as that of the Apple; ſome gummy, as the Cherry: ſome frothy, as the Elm; ſome milky, as the Fig. In Mulberries, the Sap ſeems to riſe chiefly towards the Bark; for if the Tree be cut a little into the Bark, the Sap will iſſue; but not if the Tree be pierced deeper. The Trees that have the moiſteſt Juices in their Fruit, have commonly the moiſteſt Sap in their Body: for Vines and Pears are very moiſt; but Apples ſomewhat more ſpungy. The Milk of the Fig has the Quality of Rennet, to coagulate Milk: ſo have certain ſour Herbs, wherewith they make Cheeſe in *Lent* [u].

The Differences in Timber.

39. The Timber and Wood are, in ſome Trees, more clean; and in others more knotty: and it is proper to try it, by ſpeaking at one End, and laying the Ear at the other: for if the Tree be knotty, the Voice will not paſs well. Some have the Veins more varied and chambletted; as Oak, and Maple; others more ſmooth; as Fir, and Wallnut: ſome more eaſily breed Worms, and Spiders; ſome more difficultly, as 'tis ſaid of *Iriſh* Trees. There are many other Differences that concern their Uſe: thus Oak, Cedar, and Cheſtnut, are beſt for building. Some are beſt for Plough-timber, as Aſh; ſome for Piers, that are ſometimes wet and ſometimes dry, as Elm; ſome for Planchers, as Deal; ſome for Tables, Cupboards, and Deſks, as Wallnuts; ſome for Ship-timber, as Oaks that grow in moiſt Grounds; for this makes the Timber tough, and not apt to ſhiver with Ordnance: wherein *Engliſh* and *Iriſh* Timber are thought to excel: ſome for Maſts of Ships, as Fir and Pine; becauſe of their Length, Straitneſs, and Lightneſs; ſome for Paling, as Oak; ſome for Fewel, as Aſh: and ſo of the reſt [w].

40. The

[r] There are many Conſiderations to this Purpoſe in the *French Memoirs.*

[s] Let the other Species be enumerated.

[t] What Certainty is there in this Conjecture?

[u] For an Account of the different Juices in different Parts of the ſame, or different Vegetables, ſee *Boerhaave's Chemiſtry.*

[w] Conſult Mr. *Evelyn's Sylva.* See alſo the *Acta Eruditorum*, for the Year 1708, *pag.* 163, *&c.*

Different Trees delight in different Soils.

40. The Coming of Trees and Plants in certain Regions, and not in others, is ſometimes caſual; for many Trees have been tranſplanted, and proſpered well. Damaſk-roſes have not been known in *England* above three hundred Years; tho now ſo common. But the thriving of Plants in certain Soils more than in others, is merely natural. The Fir and the Pine, love Mountains; the Poplar, Willow, Sallow, and Alder, love Rivers and moiſt Places; the Aſh loves Coppices, but is beſt in Standards alone: Juniper loves Chalk; ſo do moſt Fruit-trees: Samphire grows only upon Rocks; Reeds and Oſiers, where they are waſhed with Water: the Vine, loves the ſides of Hills, to the South-eaſt Sun [w], *&c.*

The Nature of the Soil diſcovered by the Herbs it produces.

41. The Growth of certain Herbs diſcovers the Nature of the Ground where they grow: thus wild Thyme ſhews a good Feeding-ground for Cattle; Betony and Strawberries, Grounds fit for Wood; Camomile denotes a mellow Ground, fit for Wheat; Muſtard-ſeed, growing after the Plough, ſhews a ſtrong Ground for Wheat: Burnet, a good Meadow; and the like [x].

More Superplants beſides Miſletoe.

42. Other Plants, beſides Miſletoe, grow out of Trees. In *Syria* there is an Herb called *Caſſytas*, which, growing out of a tall Tree, winds itſelf about the Tree; and ſometimes about Thorns: a kind of Polypody grows out of Trees, tho it twines not: ſo does an Herb called *Faunos*, upon the wild Olive; and another, called *Hippophæſton*, upon the Fuller's-thorn; and is ſuppoſed good for the Falling-ſickneſs [y].

Some Winds and Weather, pernicious to Trees.

43. It has been obſerved, that the cold eaſterly Winds are prejudicial to Fruit; and that South Winds alſo are hurtful; eſpecially in Blooming-time; and the more, if followed by Showers. It ſhould ſeem, that they call forth the Moiſture too faſt. Weſt Winds are the beſt. It has alſo been obſerved, that green and open Winters prejudice Trees; ſo that if two or three ſuch Winters come ſucceſſively, Almonds, and ſome other Trees, will die. The *Cauſe* is, the Earth's exhauſting itſelf too faſt.

Snows fertilize the Earth.

44. Snows lying long, cauſe a fruitful Year: for, (1.) they keep in the ſtrength of the Earth: (2.) they water the Earth better than Rain; the Earth ſucking, as it were, the Water out of the Snow: and (3.) the moiſture of Snow is the fineſt moiſture; as being the Froth of the Water-clouds [z].

When Rain is moſt ſerviceable to Fruits.

45. Showers falling a little before the ripening of Fruits, prove ſerviceable to all ſuch as are ſucculent and moiſt; *viz.* Vines, Olives, Pomegranates, *&c.* tho this rather produces plenty than goodneſs; for the beſt Wines are made in the drieſt Vintages. Small Showers are likewiſe good for Corn, if parching Heats come not upon them: generally Night-ſhowers are better than Day-ſhowers; becauſe the Sun follows not ſo faſt upon them: and we find in watering by Hand, that 'tis beſt, in Summer time, to water in the Evening.

46. The

[w] Could not the *phyſical Cauſes* of theſe Varieties be diſcovered by proper Sets of Experiments, that ſhould manifeſt the particular Nature of every Species?

[x] All the juſt Obſervations of this kind, ſhould be carefully collected.

[y] Let all the Inſtances of this kind be produced. See above *Sect.* X.

[z] Are there not other Cauſes aſſignable for the Effect? See Mr. *Boyle's Hiſtory of Cold.*

46. The differences of Earths ſhould be diligently examined. The Earth that eaſieſt ſoftens with Showers is commended; yet ſome of that kind will be very dry and hard before Rain. The Earth that throws a great Clod from the Plough, is not ſo good as that which throws up a ſmaller. The Earth that eaſily produces Moſs, and may be called mouldy, is not good. The Earth that ſmells well upon the digging, or ploughing, is commended; as containing the Juice of Vegetables almoſt ready prepared. Poorneſs of Herbs ſhews poorneſs of Earth; and eſpecially if they be dark in Colour: but if the Herbs ſhew withered, or blaſted at the Top, it denotes the Earth to be very cold; ſo does the moſſineſs of Trees. Earth where the Graſs is ſoon parched with the Sun, is commonly forced, and barren in its Nature. The tender, cheſſom, and mellow Earth, is the beſt; being mere Mould, between the two Extremes of Clay and Sand; eſpecially if not loamy and binding. The Earth that can ſcarce be ploughed after Rain, is commonly fruitful; as being cleaving, and full of Juices [z]. *The Differences of Soils.*

47. 'Tis ſtrange that Duſt ſhould make Trees more fruitful, and particularly Vines; upon which they purpoſely throw it. It ſhould ſeem that this powdering, when a Shower comes, makes a kind of Soil to the Tree; being Earth and Water finely laid on: and 'tis obſerved, that Countries where the Fields and Ways are duſty, bear the beſt Vines. *Why Duſt fertilizes.*

48. 'Tis recommended, to lay the Stalks and Leaves of Lupins about the Roots of Trees; or to plough them into the Ground where Corn is ſowed. To burn the Cuttings of Vines, and caſt them upon Land, is very good. And the Ancients generally conceived, it was beſt to dung the Ground when the Weſt Wind blew, in the Decreaſe of the Moon; the Earth being then, perhaps, more thirſty and open, to receive the Dung [a]. *Other Means of Fertilization.*

49. The Grafting of Vines upon Vines ſeems not now in Uſe; tho the Ancients had it in three Ways: the *firſt* was Inciſion, which is the ordinary manner of Grafting: the *ſecond* was Terebration thro' the middle of the Stock, and putting the Cion therein: and the *third* was, paring two Vines, that grew together, to the Marrow, and binding them cloſe [b]. *The ancient Ways of Grafting the Vine.*

50. The *Diſeaſes* and *Accidents* of Corn ſhould be enquired into; tho many of them, perhaps, are not to be remedied. (1.) *Mildew* is one of the greateſt, which proceeds from cloſeneſs of Air; whence it ſeldom happens in Hills, or large champain Ground. This cannot otherwiſe be remedied in Countries of ſmall Encloſure, than by turning the Grounds into larger Fields: which I have known to ſucceed in ſome Farms. (2.) The *Shooting up of wild Oats*, into which Corn, eſpecially Barley, is often ſaid to degenerate [c]. This happens chiefly from the weakneſs of the Grain ſown; for *The ſeveral Diſeaſes of Corn.*

[z] This is an intereſting Subject, that requires a rigorous, philoſophical, and chemical Treatment. Let the Analyſis of different Earths be made, by ſimple Elixation, Evaporation, *&c.* See Mr. *Evelyn's Terra.*

[a] Have the ſenſible Effects of particular Winds upon the Ground been carefully obſerved. See the Author's *Hiſtory of Wind*; and Mr. *Boyle's Hiſtory of Cold.*

[b] None of theſe Ways are ſaid to be effectual; but Vines are eaſily raiſed from Slips.

[c] But is there any aſſured Inſtance of Wheat, or Barley, ever degenerating into Oats?

for if it be either too cold, or mouldy, it will bring forth wild Oats. (3.) The *Satiety of the Ground*; for if Ground be ſtill ſown with the ſame Corn, the Crop will be poor: therefore, beſides the giving reſt to the Ground, we muſt vary the Seed. (4.) The *ill Accidents proceeding from Winds*; which hurt, both at the flowering, by ſhaking off the Flowers; and at the full ripening, by ſhaking out the Corn. (5.) Another ill Accident is *Drought*, at the Spindling of the Corn; which with us is rare; but in hot Countries common; inſomuch that the Word *Calamitas* was firſt derived from *Calamus*; when the Corn could not get out of the Stalk. (6.) Another is *Over-wet* at Sowing-time; which, with us, breeds Dearth; the Corn in this caſe never coming up: and frequently they are forced to ſow Summer-corn again, where they ſowed Winter-corn. (7.) Another bad Accident is, where *Froſts* continue without Snow; eſpecially in the beginning of the Winter, when the Seed is new ſown. (8.) Another Diſeaſe is *Worms*; which ſometimes breed in the Root, upon hot Suns and Showers, immediately after the Sowing. And a Worm breeds in the Ear itſelf; eſpecially when hot Suns often break out of Clouds. (9.) Another Diſeaſe is *Weeds*; ſuch as either choke or over-ſhadow the Corn, and bear it down, or ſtarve and deceive it of Nouriſhment. (10.) Another is *Rankneſs* of the Corn; which they remedy by mowing it after 'tis come up; or putting Sheep into it. (11.) Another is, the *Laying of Corn with great Rains*, near, or in Harveſt. (12.) Another bad Accident is, if the Seed happen to have touched Oil, or any fat Thing, which has a Contrariety with the Nouriſhment of Water [d].

Their Remedies.

51. The Remedies for the Diſeaſes of Corn, are, (1.) To ſteep the Grain before Sowing in Wine, for a-while. (2.) To mix Seed-corn with Aſhes. (3.) To ſow at the Wane of the Moon, is thought to make the Corn ſound. (4.) It has not been practiſed, but thought of Uſe, to make ſome Mixture in Corn; as to ſow a few Beans with Wheat. (5.) It has been obſerved, that to ſow Corn with Houſeleek is ſerviceable. (6.) Tho the Grain that touches Oil or Fat, receives Hurt; yet the ſteeping of it in the Dregs of Oil, when beginning to putrefy, which they call *Amurca*, is thought to defend it againſt Worms. (7.) 'Tis reported, that to mow Corn makes the Grain larger; but emptier, and more huſky [c].

The Goodneſs of Seed, how known.

52. Seed of a Year old is found beſt; that of two or three Years old bad; and that which is older, quite barren: tho ſome Seed and Grains keep better than others. The Corn which lies loweſt in the Vanning, is the beſt: and that which, when broken or bitten, retains a little yellowneſs, is better than that which is very white.

The Roots of Sorrel ſtrike deep.

53. Of all the Roots of Herbs, that of Sorrel is obſerved to ſtrike the deepeſt; inſomuch as to deſcend four Foot into the Earth: 'tis alſo the largeſt

[d] The ſeveral Diſeaſes of Corn ſhould be ſought and deſcribed, as fully and accurately in the *Natural Hiſtory of Vegetation*, as the Diſeaſes of the Body in the Art of Medicine.

[c] Much Accuracy, many judicious Experiments, and an ample Stock of cloſe Obſervations, ſeem requiſite to give the neceſſary light of Information in this Matter; for forming *Axioms*, and ſure Rules of Practice. See the *Philoſophical Tranſactions*; the *French Memoirs*; and the *German Ephemerides*, *paſſim*.

Root that longeſt continues fit for ſetting again. 'Tis a cold acid Herb, that ſeems to love the Earth, and is not much drawn by the Sun.

54. Some Herbs thrive beſt when watered with ſalt Water; *viz.* Radiſh, Beet, Rue, Penyroyal, *&c.* and this Trial ſhould be extended to ſome other Herbs, eſpecially thoſe that are ſtrong; as Tarragon, Muſtard, Rocket, and the like. *The watering with ſalt Water recommended.*

55. It ſeems ſtrange, that poiſonous Creatures ſhould affect ſtrong-Smelling, and wholeſome Herbs; as, that the Snake ſhould love Fennel; the Toad delight under Sage; Frogs under Cinquefoil, *&c.* but, perhaps, it is rather the Shade, or other Coverture that they affect, than the Virtue of the Herb. *Why venomous Creatures delight in particular Herbs.*

56. 'Twould be very advantageous to diſcern of what Corn, Herbs, or Fruits, there is likely to be a Plenty, or Scarcity, by certain Signs and Prognoſticks, at the beginning of the Year: becauſe ſuch as would come in plenty, might be bargain'd for upon the Ground; as 'tis related of *Thales*; who, to ſhew how eaſy it was for a Philoſopher to be rich, when he foreſaw a great Plenty of Olives, made a Monopoly of them. And for Scarcity, Men may make Profit in keeping the old Store. Long continuance of Snow, is thought to make a fruitful Year; and an early, or very late Winter, a barren Year for Corn: an open and ſerene Winter, an ill Year of Fruit. Other Prognoſticks of the like Nature, are diligently to be enquired after [f]. *Prognoſticks of Plenty and Scarcity of certain Vegetables.*

57. Great Profit may attend any conſiderable Improvement in Vegetation: and with this View we would recommend the following Experiments. *Probable Experiments of profit in Vegetables.*

(1.) The making of Compoſts of fallen Leaves, River-mud, Earth, and Chalk.

(2.) The incloſing of Earth, or ſheltering it from the Weather; to enrich it for Manure, or the yielding of Salt-petre.

(3.) The ſetting of Wheat and Peaſe, inſtead of ſowing or ſcattering them with the Hand.

(4.) The Improvement of Crops, by ſteeping the Seed in proper ſaline Liquors.

(5.) The early raiſing of Peaſe, Cherries, and Strawberries.

(6.) The ſtrengthening of Earth; that it may yield frequent Returns of Radiſhes, Parſnips, Turnips, *&c.*

(7.) The increaſing the Roots of Onions, Carrots, Radiſhes, and others of the eſculent Kind.

(8.) The ſowing the Seed of Trefoil.

(9.) The planting of Woad.

(10.) The planting of Tobacco.

(11.) Grafting upon the Boughs of old Trees.

(12.) The quick raiſing of Coppices.

[f] The ſure Way of obtaining this End, ſeems ſomewhat ſlow and laborious, as depending upon an exact *Meteorological Hiſtory*; which is not, perhaps, at preſent, extant. See the Author's *Hiſtory of Winds.*

(13.) The planting of Oſiers in wet Ground.

(14.) The preſerving of Oranges, Lemmons, Citrons, Pomegranates, all the Summer.

(15.) The ſowing of Fennel.

(16.) The multiplying and dreſſing of Artichoaks.

(17.) The fitting of Hay, Haws, Hips, Trefoil, Bramble-berries, Woodbine, wild Thyme, *&c.* for brewing, inſtead of Malt; and the uſing of Thiſtles for Hops[g].

And there are numerous Particulars of the like kind.

Peculiarities in ſome Vegetables.

58. Some Plants ſeem to have Singularities, or Particulars different from all others: the Olive has the oily Part only on the out-ſide; whilſt other Fruits have it in the Nut or Kernel. The Fir has, in effect, no Stone, Nut, or Kernel; unleſs its little Grains be accounted Kernels. The Pomegranate, and Pine-apple, among other Fruits, have only Grains diſtinct in ſeveral Cells. No Herbs have curled Leaves but Cabbage, and Cabbage-Lettuce[h]. None have double Leaves, one belonging to the Stalk, another to the Fruit or Seed, but the Artichoak. No Flower has the ſame kind of Spread as the Woodbind. This is a large field of Contemplation; for it ſhews, that, in the Production of ſome Species, there is frequently a compoſition of Matter that may be greatly diverſified; in others, a Compoſition that happens rarely, and admits of little Variety. So likewiſe, among Beaſts; Dogs have a Reſemblance with Wolves and Foxes; Horſes with Aſſes; Hares with Coneys, *&c.* So among Birds: Kites and Keſtrels have a Reſemblance to Hawks; common Doves to Ring-doves and Turtles; Black-birds to Thruſhes; Crows to Ravens; Daws to Choughs, *&c.* But Elephants, and Swine, among Beaſts; the Bird of Paradiſe, and the Peacock, among Birds, and ſome few others, have ſcarce any other Species like them.

Concluſion.

59. We leave the *Deſcription of Plants* and *their Virtues* to HERBALS, or the like Books of *Natural Hiſtory*; wherein Men have ſhewn great Diligence, even to a degree of *Curioſity:* for our *Experiments* are only ſuch as conſtantly tend to the DISCOVERY OF CAUSES, and the RAISING OF AXIOMS. Tho we are not ignorant that ſome, both *ancient* and *modern Writers*, have alſo endeavoured to tread this Path: But, to ſay the truth, their CAUSES and AXIOMS, are full of *Imagination*; and ſo infected with received and current *Theories*, as, in reality, to *corrupt Experience*, and not digeſt and ripen it[i].

VENERY.

[g] Here appear to be ſeveral uſeful Hints propoſed, and a much greater number intimated. If it were to the preſent Purpoſe, we could offer ſeveral Conſiderations, and a Set of Experiments, that might add Light and Confirmation to theſe Thoughts. But that would carry us too far beyond the Deſign of theſe Notes; which is not to *execute*, but merely to *indicate*.

[h] Conſult the Botaniſts for others.

[i] The Subject of Vegetation has been conſiderably cultivated ſince the Time of our Author; but ſeems ſtill capable of very great Improvement. It were needleſs here to refer to the common Writers upon *Agriculture*, *Horticulture*, and *Botany*; few of theſe ſeem to have underſtood the Meaning of the foregoing Enquiry; or beginning of a *Natural* and *Experimental*

VENERY.

1. IT has been obſerved, that profuſe Venery dims the Sight; yet Eunuchs alſo, are dim-ſighted. The *Cauſe*, in the former, is expence of Spirits; in the latter, over-moiſture of the Brain: which thickens the viſual Spirits, and obſtructs their Paſſage; as appears by the decay of Sight in Age; where the Diminution alſo of the Spirits concurs as another *Cauſe*. Blindneſs likewiſe proceeds from Rheums and Cataracts. Now in Eunuchs, there are all the Signs of Moiſture; as ſwelling of the Thighs, looſeneſs of the Belly, ſmoothneſs of the Skin, *&c.* *Why profuſe Venery weakens the Eyes.*

2. The Pleaſure in Venery is the greateſt of ſenſible Pleaſures; and improperly compared to Itching; tho that alſo be pleaſing to the Touch. But the *Cauſe* lies deep. All the Organs of the Senſes qualify the Motions of the Spirits; and make ſo many ſeveral Species of Motions, and Pleaſures or Diſpleaſures, as there are Diverſities of Organs. The Inſtruments of Sight, Hearing, Taſte and Smell, are different in their Make; ſo are the Parts of Generation. Therefore *Scaliger* did well to conſtitute the Pleaſure of Generation a *ſixth* Senſe[k]. And if there were any other different Organs, and qualified Perforations, for the Spirits to paſs; we ſhould have more than five Senſes. Perhaps ſome Beaſts and Birds have Senſes that we have not; and the very Scent of Dogs, is almoſt a Senſe by itſelf[l]. Again, the Pleaſures of the Touch are greater and deeper than thoſe of the other Senſes; as we find in warming upon Cold, or cooling upon Heat: for as the Pain of Touch is greater than the Offences of the other Senſes; ſo are the Pleaſures. 'Tis true, the affecting of the Spirits immediately, and as it were without an Organ, gives the greateſt Pleaſure. This happens but in two things; *ſweet Odours* and *Wine*. We ſee the great and ſudden Effect of Odours, in recovering Perſons that faint: and 'tis certain, that the Pleaſure of Drunkenneſs comes next to the Pleaſure of *Venus*. Great Joys, likewiſe, make the Spirits move and touch themſelves; and the Pleaſure in Venery is ſomewhat of the ſame kind. *Venery a ſixth Senſe.*

3. It has been always obſerved, that Men are more inclined to Venery in the Winter, and Women in the Summer[m]: for the Spirits in a Body more hot and dry, as thoſe of Men, are by the Summer more exhaled; and in Winter more condenſed: but in cold and moiſt Bodies, as thoſe of Women, the Summer cheriſhes the Spirits, and excites them; whereas *Why Men are moſt given to Venery in the Winter.*

mental Hiſtory of Vegetation; with a View to the Diſcovery of *Cauſes* and *Axioms*. Thoſe who deſire to continue the Deſign, may do well to conſult the *Philoſophical Tranſactions*; the *French Memoirs*; the *German Ephemerides*; *Malpighi*, and Dr. *Grew*'s *Anatomy of Plants*: Mr. *Evelyn*'s *Pomona*, *Sylva*, *& Terra*; *Boerhaave*'s *Chemiſtry*; and Mr. *Hales*'s *Vegetable Staticks*. But the Plan of the whole Deſign ſhould be enlarged, by the Addition of a Set of new *Titles*; and many new Sets of Experiments, relating to, (1.) The Analyſis of Plants. (2.) The Improvement of Timber. (3.) The Uſes of Fruits for making Drinks, and Wines. (4.) The beſt Ways of treating Vegetables for Food, Phyſick, Clothing, Building, Shipping, *&c. &c.*

[k] See *Jacob Thomaſius de Senſu ſexto*; *ſive Titillatione Venerea*.

[l] See Mr. *Boyle* upon *Effluvia*.

[m] *Is* this Obſervation verified?

the Winter dulls them. To abſtain or intermit the uſe of *Venery* in moiſt and well habited Bodies, breeds many Diſeaſes; particularly dangerous Impoſtumations. The Reaſon is evident; there being a ſuppreſſion of a principal Evacuation; eſpecially of the Spirits: for which, there is ſcarce any Evacuation, but in *Venery*, and Exerciſe. Whence the Omiſſion of either of them cauſes all the Diſeaſes of Repletion [m]. See the *Article* TITILLATION.

VINEGAR.

Of Vinegar. The turning of *Wine* to *Vinegar*, is a kind of *Putrefaction* [n]: and in making of Vinegar, they ſet Veſſels of Wine to the noon Sun; which calls out the more oily Spirits, and leaves the Liquors ſour and hard. So, burnt Wine is more hard and aſtringent than Wine unburnt. 'Tis ſaid, that Cyder ripens in croſſing the *Line*; when Wine or Beer turns ſour. Set a Rundlet of Verjuice to the Sun in Summer, as they do Vinegar, to ſee whether it will ripen and ſweeten [o].

VISION.

Why Globes appear flat at a Diſtance. 1. All Globes appear flat afar off: for Diſtance, being a ſecondary Object of the Sight, is not otherwiſe perceived, than by more or leſs Light; which diſparity, when it cannot be diſcern'd, all ſeems one: as it generally is in Objects not diſtinctly ſeen. So, Letters, if by reaſon of the Diſtance, they cannot be diſcern'd, ſhew but as a duskiſh Paper: whilſt all Engravings and Emboſſings appear plain at ſome Diſtance [p]. See the *Article* SOUND. Sect. XX.

2. Both

[m] The lighter part of this Subject has been conſidered, with great Curioſity, by certain Authors; but in its grave phyſical Part by few. A proper *Hiſtory of the venereal Act* requires a ſober and careful Writer; well verſed in phyſical *Anatomy*, the *Natural Hiſtory of Animals, and Phyſick.*

[n] It may be called a real *Putrefaction*; allowing that word to ſtand for a Change of one Body into another, of very different Properties; but let the common acceptation be guarded againſt; which denotes rather the *Corruption* and *Deſtruction* of a Thing, or its becoming unfit for certain Uſes. This is not the *Philoſophical Senſe* of the *Word.* See *Boerhaave's Chemiſtry*, in the Chapter of *Fermentation*, *vinous* and *acetous.*

[o] The *Hiſtory of Vinegar* requires many curious Experiments, that might open a new Scene in *Natural Philoſophy.* It would certainly point out an *uncommon Doctrine*, with regard to *Tranſmutations.* But I know not how, it ſeems in a manner to be overlook'd by the generality of *Philoſophers:* tho it muſt be allow'd that *Glauber*, *Becher*, and *Stahl* have ſome original Experiments for diſcloſing its Nature. And *Boerhaave* in his Chemiſtry, has collected together many Particulars from other Authors, relating to it. But the Subject enfolds many *Myſteries*, that require a ſtrict *Philoſophical Search*; able to inform the *Vinegar-maker*; and teach him much *ſhorter* and more *profitable* ways of working. For Vinegar may be made from numerous cheap *Materials*, in a very ſmall compaſs of Time; without depending upon the Sun; which is exceſſively tedious; and without the uſe of *Rape*, &c. And it is ſtrange the *Chemiſts*, and thoſe who prepare large quantities of *Saccharum Saturni*, which requires a large proportion of diſtill'd *Vinegar*, ſhould not be acquainted with theſe *gainful Methods.* The Chemiſts may, if they pleaſe, prepare their *Vinegar*, for this purpoſe, from *Treacle* and *Water*; in a few days time. See the *Articles* MATURATION and SUGAR.

[p] Conſult the *Writers of Opticks* upon this Head; and Mr. *Berkley's Dialogues of Viſion.*

2. Both Eyes move the ſame way: for when one Eye moves to the Noſtril, the other moves from the Noſtril. The *Cauſe* is Motion of Conſent; which is ſtrong in the Spirits, and ſpiritual Parts: yet Uſe will induce the contrary; for ſome can ſquint when they will: and the common Tradition is, that if Children be ſet upon a Table with a Candle behind them, both Eyes will move outwards; as affecting to ſee the Light; and ſo cauſe ſquinting [q]. *Why both Eyes move the ſame way.*

3. We ſee more exquiſitely with one Eye ſhut, than with both [r]; becauſe the vital Spirits thus unite themſelves the more, and become the ſtronger. For we may find by looking in a Glaſs, whilſt we ſhut one Eye, that the Pupil of the other dilates. *Why one Eye ſees ſtronger than two.*

4. If the viſual Rays meet not in one Angle, the Eyes ſee double; for ſeeing two Things, and ſeeing one Thing twice, works the ſame Effect: and therefore a little Pellet held between two Fingers laid a-croſs, feels double. *The Cauſe of double Viſion.*

5. Pore-blind Men ſee beſt in a dim Light; have their Sight ſtronger near hand; and can read and write ſmaller than thoſe who are not pore-blind: Becauſe the viſual Spirits, in the pore-blind, are thinner and rarer than in others; and therefore the greater Light diſperſes them. For the ſame reaſon they need contracting; but being contracted, they are more ſtrong than the viſual Spirits of ordinary Eyes; as when we ſee thro' a Level, the Sight is ſtronger: ſo it is when we gather the Eye-lids ſomewhat cloſe: and 'tis common for thoſe that are pore-blind to gather the Eye-lids. But old Men, when they would read, hold the Paper at ſome Diſtance; for the viſual Spirits of old Men unite not, but when the Object is at ſome diſtance from their Eyes [s]. *Why pore-blind Men ſee well near hand.*

6. When Men look towards the Sun, or a Candle, they ſee better by putting their Hand a little before the Eyes; for the glaring of the Light, weakens the Eye: whereas the Light diffuſed abroad is ſufficient for Viſion; too much Light making the Eyes dazzle; and a perpetual looking againſt the Sun would cauſe Blindneſs. Again, upon coming out of a great Light into the Dark; and coming out of the Dark into the Light, Men ſeem to have a Miſt before their Eyes; and ſee worſe than after they have ſtayed a little while, either in the Light, or in the Dark: for the viſual Spirits are, upon a ſudden Change, diſturbed and put out of order; and till recollected, do not perform their Function well: when they are much dilated by Light, they *Why Viſion is beſt, when the Eye is ſhaded.*

[q] There ſeems to be Truth in this common Obſervation; inſomuch that if Children are placed in the Cradle, where the Light comes ſidewiſe, it is found to make them ſquint. And the Cure is effected by a proper Contrivance to make them look right before; that the Rays of Light may ſtrike the Pupilla perpendicularly.

[r] Do not Objects to ſome People, appear alſo conſiderably larger, when they uſe one Eye, than when they uſe both? And what is the phyſical Reaſon thereof?

[s] Opticians now generally explain theſe Matters in a Mathematical manner; making the viſual Rays, or Rays of Light to be Lines; the Humours of the Eye a kind of Glaſſes; and the Retina, or Expanſion of the Optic Nerve at the bottom of the Eye, the Seat or Canvas of a miniature Picture thus produced, reſembling the original Object. But to diſcover the efficient Cauſe and Manner of Viſion, requires a more phyſical Search.

they cannot contract ſuddenly; and when much contracted by Darkneſs; they cannot dilate ſuddenly. And exceſs both of Contraction and Dilatation, if long continued, deſtroys the Organ. For as long looking againſt the Sun, hurts the Eye by Dilatation; ſo Miniature Painting, and the reading of ſmall Letters, hurt it by Contraction [t].

Why the Eyes become red in Anger.

7. It has been obſerved, that in Anger the Eyes become red; and in bluſhing, not the Eyes, but the Ears, and parts behind them. The *Cauſe* is, that in Anger, the Spirits aſcend and grow brisk; which is eaſily ſeen in the Eyes, that are tranſparent; tho withal it makes both the Cheeks and Throat red: and in bluſhing, the Spirits aſcend to ſuccour both the Eyes and the Face, which are the parts that labour: but then they are repulſed by the Eyes, becauſe the Eyes in ſhame put back the Spirits that aſcend to them; as unwilling to look abroad: for all Men in that Paſſion appear dejectedly; and this repulſe from the Eyes, diverts the Spirits and Heat more to the Ears, and parts adjacent [u].

Why the ſight has no diſagreeable Object.

8. The Objects of Sight, tho they may cauſe a great Pleaſure, yet give no Pain, or great Offence, unleſs by Memory. The play of Diamonds that ſtrike the Eye; *Indian* Feathers of curious Colours; the coming into a fine Garden, or Room richly furniſh'd; a beautiful Perſon, *&c.* greatly delight and exhilerate the Spirits. The Reaſon why the Effect holds not in giving Offence, is, that the Sight, being the moſt ſpiritual of the Senſes, has no Object groſs enough to offend it. But the principal *Cauſe* is, that there are no active Objects to offend the Eyes. Harmonical Sounds, and Diſcords, are both active and poſitive; ſo are good and bad Odours; bitter and ſweet Taſtes; too great Heat and Cold to the Touch; but Blackneſs and Darkneſs are Privatives; and therefore have little or no activity. However, they do ſomewhat ſadden the Mind; tho very little. See the *Article* SENSES.

How Objects appear by Refraction.

9. Light by Refraction ſhews Objects larger, as well as colour'd: for as a Shilling at the bottom of Water appears larger, ſo will a Candle in a Lanthorn under Water. I have heard that Glow-worms, included in Glaſſes, are put into Water to make the Fiſh come together: but whether a Diver having his Eyes open, and ſwimming upon his Back, ſees Things in the Air, greater or leſs, I am not certain. 'Tis manifeſt, when the Eye is in the finer Medium, and the Object in the groſſer, Things appear larger; but when the Eye is in the groſſer Medium, and the Object in the finer, the Experiment remains to be tried [v].

Refractions to be tried after Reflections.

10. It ſhould be well examin'd whether great Refractions may not be made upon Reflections; as well as upon direct Rays. For Example, if you put a Shilling into an empty Baſon, then go ſo far from the Baſon, that you cannot ſee the Shilling; if the Baſon be now fill'd with Water, you will

[t] But the Eye is found to dilate and gradually accommodate itſelf to a ſmall degree of Light, or what is commonly called Darkneſs; whence Men have been able to ſee ſmall Objects in dark Dungeons.

[u] See the *Article* PASSIONS.

[v] See Sir *Iſaac Newton's Opticks*, paſſim.

will ſee the Shilling out of its place. Therefore, put a Looking-glaſs into a Baſon of Water; and I ſuppoſe you will not ſee the Image in a right Line, or at equal Angles, but on one ſide. Perhaps this Experiment might be ſo extended, that one ſhould ſee the Image, and not the Glaſs; which would ſeem ſtrange: for then the Image would appear like a Phantom in the Air. For Example, place ſome ſtrange Picture over a Ciſtern of Water; ſo that you may not ſee the Water: then put a Looking-glaſs into the Water; and now if you can ſee the Picture aſide, without ſeeing the Water; it would appear very ſurprizing. They have an old Tale in *Oxford*, that Friar *Bacon* walk'd between two Steeples: which was thought to be done by Glaſſes; whilſt he walked upon the Ground [w].

ULCERS.

'Tis noted by the Ancients, that in groſs or impure Bodies, Ulcers in the Legs are hard to cure; but in the Head more eaſy: for Ulcers in the Legs require Deſiccation, which the defluxion of Humours to the lower Parts hinders; whereas Ulcers in the Head require it not. And in modern Obſervation, the like Difference has been found between *Frenchmen* and *Engliſhmen*; the Conſtitution of the one being more dry, and of the other more moiſt: whence, a Wound in the Head of a *Frenchman*, but in the Leg of an *Engliſhman* is harder to cure [x]. See the Articles SWELLINGS and WOUNDS.

The Cure in ſome Ulcers.

W.

WATER.

WAter looks blacker when moved, and whiter when at reſt. Becauſe, by reaſon of the Motion, the Rays of Light paſs not direct; as they do when the Water is at reſt. Beſides, Splendor has a degree of whiteneſs; eſpecially if there be a little Repercuſſion: for a Looking-glaſs with the Foil behind, looks larger than a bare Glaſs [y]. This Experiment deſerves to be carried farther, in diſcovering by what means Motion may hinder Sight [z].

Why Water looks black when moved.

2. 'Tis a Thing of great Uſe to diſcover the goodneſs of Waters. The Taſte, to ſuch as drink Water only, may do ſomewhat: but other Experiments

Trials to diſcover the goodneſs of Water.

[w] There are many Curioſities of this kind practicable, from a commanding Knowledge in Opticks, and the Properties of Glaſſes, variouſly figured, diſpoſed and combined. See the Writers upon *Opticks*, *Dioptricks* and *Catoptricks*; and conſider of the proper Combinations for the purpoſe.

[x] The Enquiry how far the Effects of Climate and Conſtitution reach in accelerating or retarding the Cures of Diſeaſes, ſeems not duly proſecuted. Perhaps the Remedies proper for a Diſeaſe in one Country, may ſometimes prove pernicious in another; as ſeems to be the Caſe of *Lime-water*, uſed in *England* and *France*. See *Memoir. de l' Acad.* An. 1700.

[y] Do not all Bodies that reflect Light ſtrongly, look larger than thoſe that reflect it weakly? And is not this owing to the diffuſive, or ſpreading Nature of Light, throwing itſelf out every way?

[z] As by great Velocity, Unſteadineſs, *&c.*

riments are more ſure. (1.) Try Waters by weight; wherein you may find ſome difference; and account the lighter the better. (2.) Try them by boiling upon an equal Fire: and that which conſumes faſteſt account the beſt. (3.) Try them in ſeveral open Veſſels of equal ſize; to ſee which laſts longeſt, without Stench or Corruption: And that which keeps longeſt unputrefied, account the beſt. (4.) Try them by making Drinks ſtronger or ſmaller, with the ſame quantity of Malt; and conclude that the Water which makes the ſtronger Drink, is more concocted and nouriſhing; tho perhaps it be not ſo good for medicinal Uſe. And ſuch commonly is the Water of large navigable Rivers; and large and clean ſtagnant Ponds: upon both which the Sun has more power, than upon Fountains or ſmall Rivers. And I conceive that Chalk-Water is next to theſe the beſt, for going far in Drink: as this alſo helps Concoction; if drawn out of a deep Well; which thus cures the rawneſs of the Water: but chalky Water, towards the top of the Earth, is too fretting; as appears in the Laundry: for Linens waſh'd with ſuch Waters, wear out apace. (5.) The good Houſe-wives find a difference in Waters for bearing or not bearing of Soap: and 'tis likely that the fat Water will bear Soap beſt; for hungry Water kills the unctuous Nature of the Soap. (6.) Judgment may be made of Waters according to the place from whence they ſpring or come: Rain-water is by Phyſicians eſteemed the fineſt and beſt; yet it is ſaid to putrefy ſooneſt [a]: which is likely, becauſe of the fineneſs of the Spirit: and in Conſervatories of Rain-water, 'tis not found excellent; the worſe perhaps, becauſe they are cover'd above, and kept from the Sun. Snow-water is held unwholeſome; inſomuch that the Inhabitants at the foot of Snow-Mountains, by drinking of Snow-water, have great Bags under their Throats. Well-water, except it be upon Chalk, or a very plentiful Spring, makes Meat red; which is an ill ſign. Springs on the tops of high Hills are the beſt: becauſe they ſeem to have a Lightneſs; and are more pure and unmixed, and better percolated thro' a great ſpace of Earth. For Waters of Valleys, in effect, join under Ground, with all Waters of the ſame Level; whereas Springs on the tops of Hills, paſs thro' a deal of pure Earth, with leſs mixture of other Waters. (7.) Judgment may be made of Waters by the Soil, whereon they run; as that upon Pebble is the cleaneſt and beſt taſted; next, that upon Clay; thirdly, that upon Chalk; Fourthly, that upon Sand; and the worſt of all is that upon Mud. Nor ſhould we truſt to Waters that taſte ſweet; for they are commonly found in riſing Grounds of great Cities, and muſt needs receive much Filth [b].

How Water operates upon contiguous Air.

3. Water being contiguous to Air, cools, but does not moiſten it; except the Water evaporates; for *Heat and Cold have a virtual Tranſition, without Communication of Subſtance*; *but Moiſture* not: and all Madefaction requires an Imbibition

[a] Is that Rain Water apt to corrupt, which has by ſtanding depoſited its Sediment, not in a Wooden, but a clean Glaſs or Stone Veſſel; and been drawn off pure into another Veſſel of the ſame kind?

[b] This Subject of Water has been in ſome meaſure proſecuted by Mr. *Boyle*; and ſince by Dr. *Hoffman* in a great variety of judicious Experiments. See his *New Experiments and Obſervations upon Mineral Waters*; and Dr. *Boerhaave's* Chapter of Water, in his *Chemiſtry*,

Imbibition. But where the Bodies are of ſuch different Gravities as not to mix; there can follow no Imbibition. Whence Oil lyes on the top of the Water, without commixture: and a drop of Water running ſwiftly over a Straw or other ſmooth Body, does not wet it [c]. See the *Article* AIR.

WEATHER.

'Tis an Obſervation among Country People, that plentiful Years of Haws commonly portend cold Winters. They aſcribe it to Providence, that reaches even to the falling of a Sparrow; and much more to the preſervation of Birds in ſuch Seaſons. The *Natural Cauſe* may be the want of Heat, and abundance of Moiſture, in the preceding Summer, which puts forth theſe Fruits, and muſt needs leave a great quantity of cold Vapours undiſſipated; and thus produces the Cold of the following Winter [d]. See the *Article* DIVINATION. *A prognoſtick of* hard Winters.

WINDS.

Mens Bodies are heavier, and leſs diſpoſed to Motion, when Southern Winds blow, than when Northern: for when the Southern Winds blow, the Humours, in a manner, melt, grow fluid, and ſo flow into the Parts; as we ſee in Wood, and other Bodies; which ſwell with a South Wind. Beſides, the Motion and Activity of the Body conſiſt chiefly in the Nerves and Sinews; which relax with a Southern Wind [e]. *The Changes in the Body from* Winds.

WINE.

1. 'Tis ſaid they have a way of preparing their *Greek* Wines, ſo as to keep them from fuming and inebriating, by adding Sulphur, or Alum; whereof the one is unctuous, and the other aſtringent. And indeed thoſe two Natures beſt repreſs Fumes. This Experiment ſhould be transfer'd to other Wine, and ſtrong Beer, by putting the like Subſtances to the fermenting Liquor; which may make them both fume and inflame the leſs [f]. *The Correction of Wine recommended.*

2. The uſe of Wine is hurtful in dry and emaciated Bodies; but in moiſt and full Habits beneficial. For the Spirits of the Wine prey upon the *radical Moiſture*, as they term it, of the Body; and ſo defraud the animal Spirits. But where there is Moiſture ſufficient or ſuperfluous, Wine helps to digeſt, and dry it up [g]. *The power of Wine.*

[c] Is this Effect wholly owing to a difference in the Gravity of the Bodies? See *Boerhaave's Chapter of Menſtruums.*

[d] See the *Author's Hiſtory of Winds.*

[e] See the Author's *Hiſtory of Life and Death*, and *Hiſtory of Winds.*

[f] Does the way of correcting the *Greek* Wines here mentioned, turn upon the uſe of Sulphur, or Alum in Subſtance; or in Fume, or acid Spirit? The uſe of burning Brimſtone in the way of *Match*, as the Wine-Coopers call it, is common, and of very extraordinary Efficacy; tho overlook'd by Philoſophers. And the beneficial uſe of the acid Spirit of Sulphur, or Alum, is a ſecret in Wines, that lies in few Hands. The *Natural*, and *Experimental Hiſtory of Wines* is greatly wanted; as well for the improvement of Philoſophy, as the Service of ordinary Life. See the *Article* SUGAR.

[g] There is wanting a ſolid Account of the Virtues and Uſes of Wines; to be drawn from Experience and Obſervation; without indulging Levities, or running out into *Encomium* or *Invective.*

WOUNDS.

Wounds to be treated with Braſs Inſtruments.

1. 'Tis noted, by the Ancients, that Wounds made with Braſs, heal eaſier than thoſe made with Iron: for Braſs has a healing Virtue; whereas Iron is corroſive. It were therefore proper, to have chirurgical Inſtruments made of Braſs, rather than Iron [h].

Wounds how beſt healed.

2. 'Tis obſerved that a Sheep-ſkin newly pulled off, or Whites of Eggs applied to Wounds, will keep them from ſwelling or exulcerating; and heal them. The *Cauſe* is a temperate Conglutination; for both theſe Bodies are viſcous, and reſtrain the Flux of Humours to the Part, without penning them in [i]. See the *Articles* SWELLINGS, and ULCERS.

YAWNING.

Dangerous to pick the Ear in Yawning.

IT has been noted dangerous, to pick the Ear whilſt one yawns: for in Yawning, the inner part of the Ear is extended, by drawing in the Breath; as both in Yawning and Sighing, the Breath is firſt ſtrongly drawn in, and then ſtrongly expelled [k].

INSTAU-

[h] Is the ancient Obſervation juſt, upon which this Direction is founded? For the medicinal Virtues of the ſeveral Metals, ſee *Boerhaave's Chemiſtry*, under the Proceſſes upon Metals.

[i] The Method of *curing Wounds by the firſt Intention*, has not been diligently proſecuted; but rather meets with Oppoſition.

[k] Let a nearer Approximation be made to the *Cauſe*; if the *Fact* be ſufficiently verified.

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End of the SYLVA SYLVARUM.

INSTAURATION.

PART IV.

INSTAURATION.

PART IV.

BRITISH MUSEUM

End of the SYLVA SYLVARUM.

SCALA INTELLECTUS:

OR, THE

Progreſs of the Underſtanding

IN

PHILOSOPHICAL ENQUIRIES:

SHEWING, BY

EXAMPLES,

The METHOD of Employing the

Materials of the SYLVA SYLVARUM;

And Illuſtrating the

Rules and Directions of the *NOVUM ORGANUM*,

For Building a

SOUND PHILOSOPHY,

By the MEANS of

PARTICULAR HISTORIES.

SCALA INTELLECTUS:

OR, THE

Progress of the Understanding

IN

PHILOSOPHICAL ENQUIRIES:

SHEWING, BY

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The METHOD of Employing the

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Rules and Directions of the NOVUM ORGANUM,

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BRITISH MUSEUM

PREFACE.

THE *Author appears to have publiſhed nothing with a direct and immediate View to the* fourth Part *of his* INSTAURATION. *The Deſign of that Part was to contain a competent Set of* Examples, *or* Models, *for working with the Mind, in philoſophical Subjects, according to the genuine* Laws of Induction; *intimated, and, in ſome meaſure, explained, in the* Novum Organum. *We are, therefore, to underſtand the following Pieces of* Life and Death, *&c. not as Examples of a* genuine Induction; *but as mixed Writings, which deliver Matter of Natural Hiſtory, in a Method approaching to that of Induction; but frequently interrupted by large* Obſervations, Admonitions, *and* Directions. *Indeed it ſhould ſeem, that the Author deſigned to have digeſted and improved all the Matters collected in his* Sylva Sylvarum, *after the manner of theſe Examples; in order to facilitate the Buſineſs of ſtrict* Induction, *that was to follow in the intended* fourth Part *of the* INSTAURATION; *the perfecting whereof belonged to the* ſixth. *In the room, therefore, of the intended Set of more rigorous* inductive Hiſtories, *are here ſubſtituted a ſomewhat looſer kind; of the ſame general Nature, Method, and Tendency. And perhaps the Author might find, that the imperfect State of Philoſophy in his Time, could ſcarce, to advantage, allow of a more rigorous Induction, without launching into* mathematical *or* metaphyſical *Conſiderations; which would have been deviating from his Purpoſe. At leaſt, he ſeems to have choſe, if not the moſt ſtrict, yet the moſt inſtructive Method of* Inductive Hiſtory; *whereby the ſucceeding Philoſophers might be directed how to conduct and proſecute Enquiries in the more perfect manner; and gradually proceed to* Axioms, *and capital* Rules of Practice.

INTRO-

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INTRODUCTION[a].

The Author's View to free and reſtore the Senſes.

1. THEY who have not acquieſced in the Doctrines and Poſitions of the Ancients, whether from a Firmneſs of Mind, as is ſometimes the Caſe; or from a Levity of Temper, which more frequently happens; generally defend their procedure with this Argument; that tho they relinquiſh Antiquity, yet they produce ſuch Things of their own as are perfectly agreeable to Senſe: and that if other Men were not awed by Authority, and durſt truſt to themſelves, they would eaſily come over to this ſide. But for our own part, we neither offer Violence to the Senſes by Contradiction, nor deſtroy them by Abſtraction; but have ſupplied them with a much larger Fund of Matter than others. We wou'd correct their Errors by various Adminiſtrations, enlarge their Powers, improve their Judgment, condemn their Illuſions, and by bringing Reaſon into a due Frame, confirm, ſtrengthen, and guard them; thus endeavouring to perform what others only profeſs; and really defend, confirm and improve the Senſes: the Tendency of our whole Philoſophy being little more than to free and reſtore them [b].

Yet expects no great Credit.

2. Yet we promiſe ourſelves no great Influence upon the Belief of Men; becauſe our Method agrees with none of thoſe that have gone before us; but proceeds quite contrary thereto. For they who before us, being ſick of the Doctrine of the Ancients, applied to Senſe and Experience, as to a thing almoſt entirely new; have, generally, at firſt made ſome Enquiries with Vigour and Reſolution, under the Conduct of the Senſes; and ſeized upon thoſe Things which ſeem'd to them of a more general Nature: and from ſuch detach'd Parcels of Experiments they immediately proceeded to form Theories; and thus philoſophized by ſtarts, with narrow Views; and judged of all Things by a few.

Which the imperfect Method of philoſophizing has gain'd.

3. This imperfect Method of philoſophizing is, however, often ſucceſsful, in gaining Credit, from the narrowneſs of the Mind, which is principally moved by ſuch Things as ſtrike and enter it at once; and being deſirous of acquieſcing in ſome one Thing, either neglects all the reſt; or elſe, in a certain imperceptible manner, ſuppoſes that all Things elſe are correſpondent to thoſe few which naturally fill and diſtend the Imagination.

[a] The following *Introduction* to the fourth Part of the INSTAURATION, is collected from certain ſcatter'd Fragments in the *Scripta*, publiſhed by *Gruter*.

[b] See the *Novum Organum*, Part II.

The Method chose by the Author.

4. We, on the contrary, who desire to introduce not handfuls of Experiments, or little detached Systems of Things; but the whole Universe with its Works, as formed by the great Creator; and aim to pronounce according to the Truth and Result of Things; scarce know which way to turn ourselves, or on what side to sollicit our entrance into the Mind, and gain a Credit to what we are about. For the Things we have to offer go deeper than Notions; and spread wider than partial Experiments. Whence it must necessarily happen, that the greatest part of what we deliver will not satisfy the over-hasty and quick Apprehensions of Sense; to which some of our Doctrines will appear hard and incredible, almost like Points of Religion. For the Senses certainly deceive us; tho not when duly rectified and assisted. We therefore enter upon a new way of delivering ourselves, agreeable to the Work we have in hand; and proceed, not by disputing, or by producing a few scattered Experiments; both which ways might frustrate our End, as our Determinations are neither founded upon Notions, nor upon maim'd and divided Experience: but we use Experiments collectively; lead the Mind, in a continued Chain, to the Fountain of Things; and set to view the whole process of the Understanding, with the Advantages and Uses to be derived therefrom. Those therefore, who either rest upon Arguments, or depend upon a few Experiments, or, thro' a narrowness of Mind, submit to Authorities, or for want of opportunity, cannot give our Works their due perusal, and must not expect to comprehend our meaning.

The Opinion that nothing is knowable consider'd.

5. It would be a difficult Task to confute those who will have nothing to be knowable; even tho we candidly interpret the Expression. For if any one should maintain that true Knowledge is the Knowledge of Causes; and that the Knowledge of Causes is continually rising and climbing, in a certain Series, to Things the best known in Nature; so that a Knowledge of Particulars cannot be properly had without an exact Comprehension of universal Nature; it is not easy, on the footing of sound Judgment, to maintain the contrary. For it seems improbable, that any true Knowledge can be had, till the Mind is perfectly versed in the Explanation of Causes: and to attribute a complete Knowledge of the Universe to the human Mind, might seem rash and injudicious.

The Disadvantage of that Opinion.

6. On the other hand, the Patrons of this Opinion, without explaining themselves in this way, have ventured to profane the Oracles of the Senses; which is bringing Things to the utmost Despair. But to say the Truth, tho they had not thus calumniated the Senses, yet the Dispute might seem to be contentious, and unseasonable; since without that precise Truth they seem to mean, there is such a wide Field left open to human Industry, as makes it preposterous, and almost Madness to be sollicitous about securing the extremities of Things; and at the same time overlooking, and disregarding Things of such infinite Use as lie in the middle. For how much soever they wou'd seem to destroy the Certainty, and yet retain the Use of Knowledge, by their Distinction betwixt Truth and Probability; and with regard to the active Part, leave a free Choice of Things; yet by taking away the Hopes of discovering Truth, they have doubtless cut the Sinews of Enquiry;

and

and by a confuſed licentiouſneſs in their own Searches, turned the Buſineſs of Invention and Diſcovery into Diſputes, and the Exerciſe of the Wit.

The Author's agreement with the Ancients.

7. We cannot however deny, that if we have any Fellowſhip with the Ancients, 'tis principally in this their kind of Philoſophy; as we approve many of the Things they have prudently obſerved, and delivered, upon the Deceptions of the Senſes, the Weakneſs of the Judgment, and the withholding of the Aſſent. And to theſe we might add many other Particulars of the ſame Tendency: ſo that the difference betwixt them and us only lies here, that they will have nothing to be juſtly knowable in any way; and we not in the way which Men have hitherto gone. And if we admit into our Society, not only ſuch of the Ancients as hold this Opinion in Theory, and Speculation, but ſuch alſo as manifeſt the ſame in Queſtions and Objections, either by loudly complaining of the obſcurity of Things, or ſecretly revolving it in their Minds, and only now and then whiſpering it out; there will be found the greateſt Men of Antiquity in the Number: Heroes in Contemplation, and ſuch whoſe Company any one might wiſh to be found in. For tho perhaps one or two of the Ancients have ſhewn a Confidence, and a Poſitiveneſs in pronouncing; yet this has been no prevailing practice till of late, in barbarous Ages; and is only ſtill retain'd thro' Faction, or Party Negligence and Cuſtom.

His difference from them.

8. But as to the Society we thus join in, every one will eaſily perceive that we only concur with them in the ſetting out; and differ widely from them in the End: for altho there may at firſt ſeem no great Difference between us, as they ſimply aſſert the inſufficiency of the human Underſtanding; and we only in a certain reſpect; yet at laſt they, neither diſcovering, nor hoping to diſcover, any Remedy of the Misfortune, forſake the Buſineſs, and falling foul on the Certainty of the Senſes, ſubvert the firmeſt Foundations of Science: whilſt we, by introducing a new Method, endeavour to rectify and repair the Errors, both of the Senſes and the Mind itſelf. So that whilſt they, looking upon the Thing as paſt Recovery, give themſelves up to a certain Licentiouſneſs, and wandring of Thought; we, from our Preconception, have undertaken a more remote and difficult Task, which we ardently wiſh may redound to the Felicity of Mankind.

Tranſition to the Deſign of the Scala Intellectus.

9. The Entrance of the Road we purſue is deſcribed in the *ſecond* Part of our INSTAURATION, or *Novum Organum*; and follow'd in the *third* Part, the *Phænomena of the Univerſe*, in our *Sylva Sylvarum*; where we endeavour'd to penetrate, and paſs thro' the *Woods of Nature*, thick ſet and darken'd with a great variety of Experiments, as with Leaves; and entangled and twined together, like Shrubs and Buſhes, with the ſubtilty of Obſervations [c]. We are

[c] Hence appears another Reaſon why the Author's *Hiſtory* of *Nature* was entituled *Sylva Sylvarum*; beſides that of the ſimple meaning of thoſe words, denoting only a *Repoſitory* or *Magazine* of Materials, of all ſorts: for the figurative Senſe is, as here explained, a thick Wood of Experiments and Obſervations; and with relation thereto, the *fourth Part* of the INSTAURATION is ſometimes called *Filum Labyrinthi*; as being the *Clue* of the *Sylva Sylvarum*

now perhaps proceeding to the more open Parts of Nature; which however are ſtill more difficult; and having got thro' the Woods, are come to the bottoms of the Mountains: for tho the way was never attempted before, we ſhall lead on from *particular Hiſtories to Univerſals*, in one certain and continued Path.

The two ways of the Ancients.

10. And here we cannot but obſerve, that thoſe two famous Ways of the Ancients in active Life, have a great Correſpondence with the ways of Contemplation; the one whereof being at the firſt plain and eaſy, leads on to cragged, dangerous, and impaſſable Places; but the other beginning ſteep and difficult, ends in a Plain: for in the ſame manner, he who at the firſt Enquiry into Nature, lays hold of certain immovable Principles in the Sciences, and truſting to them, ſhall hope to find out every thing elſe, as it were at Leiſure; if he proceeds in his Enquiries, without being over ſatisfied or diſſatisfied by the way, will find himſelf got into the firſt of theſe Roads. But he that ſhall be able to withhold his Judgment, aſcend by degrees, and paſs as it were over the tops of Mountains, climbing firſt up one, then up another, and ſo to a third, with true Patience and unwearied Diligence; will in due time arrive at the Heights and top Rounds of Nature, where there is a ſure Footing, a ſerene Station, and a beautiful proſpect of Things; with a gentle and eaſy Deſcent, leading down to all practical Arts [d].

The Scheme of the Scala Intellectus.

11. Our Deſign therefore is this; that as in the *ſecond* Part of our INSTAURATION, we have laid down Precepts for a juſt and legitimate Enquiry into Nature; ſo in this *fourth Part* we wou'd give *Examples* of ſuch an *Enquiry*, in a variety of Subjects; in ſuch a *Manner* as we judge to have the exacteſt Correſpondence with Truth: and therefore deliver as a *Manner* choſen and approved.

The Method of Enquiry it purſues.

12. We do not however, after the common Cuſtom of Men, propoſe our own Forms and Methods of Enquiry, as if they were inviolable, the only ones, and perfect in all their Parts; ſo as to make it abſolutely neceſſary to uſe them: for we would by no means cramp or confine the Induſtry and Felicity of Mankind. There is no doubt but Men of Genius and Leiſure, either of themſelves, or as being now freed from the Difficulties which neceſſarily attend the firſt breaking of the Ice of Experience, may carry our *Method* to greater Perfection [e]: and 'tis our earneſt Deſire, that the true Art of conducting Enquiries ſhould improve; as it certainly will, ſince all Arts muſt improve with new Diſcoveries. Only this we muſt ſay, that after trying all the ways we could think of, and having had long Experience of our preſent Method of conducting Enquiries, we have found none equal to it, for the commodiouſneſs it affords in working with the Underſtanding.

13. If

[d] Hence we ſee the Reaſon why this *fourth Part* of the INSTAURATION is ſometimes called *Scala Intellectus*, or the Steps of the Underſtanding; by which it aſcends to the Regions of Truth; or, without a Figure, to the general Axioms of ſound Philoſophy; that at once contain both the Theory and Practice of all Arts and Sciences. And this Philoſophy was to have been the ſixth and laſt Part of the INSTAURATION.

[e] The Author's *Motto* is MONITI MELIORA. See Dr. *Hook*'s Method of improving Philoſophy; and M. *Tſchirnhaus*'s *Medicina Mentis*.

13. If we are accuſed of going into a *new Way* of acquiring and delivering Knowledge, and dropping the Method of Procedure by Doctrine and Precept, as if we over-looked it; and principally proſecute the Buſineſs by Examples; we anſwer, that we think there is the utmoſt Reaſon for this Procedure. And we would not have Mankind ignorant of the Courſe we take; for 'tis their Buſineſs, not our own, that is now before us: and we judge their common Fortune is concerned in the Execution. *Is a new Method.*

14. And firſt; we ſeem by this Method to ſecure one principal Point, which is that of being clearly underſtood: for 'tis one thing to ſubjoin Examples to particular Precepts, reſpectively; but a very different one, to conſtruct and exhibit a perfect, and, as it were, ſolid Figure and Model of the whole Work. Thus, for inſtance, ſeveral Problems in Mathematicks and Aſtronomy may, by the Aſſiſtance of Globes and proper Machines, be clearly and eaſily ſolved; and would, without ſuch Contrivances and Aſſiſtances, appear much more difficult and perplexed than they really are. And here it uſually happens, that the larger the Inſtrument is; the clearer and more ſatisfactory the Demonſtration proves. *Its Advantages; viz. rendering Things intelligible.*

15. We alſo hope to find a conſiderable Advantage from this ſimple and gentle Procedure; which neither offers Violence, nor lays Snares for the Judgment; but barely, and nakedly, exhibits the Thing. No Writer before us has led Mankind to the Fountains of Nature, and Things themſelves, for a common Good; but all of them have applied Examples and Experience to confirm or illuſtrate their own Dictates and Doctrine, without leaving others the liberty of judging for themſelves: inſomuch that we hope to have deſerved well of Mankind, in two things which they hold dear; for we leave them at once in poſſeſſion both of *Power* and *Liberty:* Power, with regard to Works; and Liberty, in point of Judgment. *Leaving the Reader poſſeſſed both of Power and Liberty.*

16. And as, in Courts of Juſtice, that Procedure is ever the beſt, where leaſt room is given to the licentiouſneſs of the Pleader, tho ever ſo eloquent; but all the time and pains are beſtowed in examining the Witneſſes: ſo, in the Courts of Nature, the Judgments of Men are then beſt employed, when the leaſt Liberty is allowed to Contention, Diſpute, and plauſible Diſcourſe; but the Mind wholly employed upon examining the Evidence, and collective Teſtimonies of Experience: for, in the Teſtimonies of Authors there is Heat, and Licentiouſneſs; but the Anſwers and Teſtimonies of Things themſelves, tho they may indeed be ſometimes obſcure and perplexed, yet they are always ſincere and uncorrupt. *To imitate the Procedure in Courts of Juſtice.*

17. Again, we ſeem by this means to keep clear of a great Inconvenience, that might ariſe from the Pride and Prejudice of Mankind: for prudent, grave, and wary Men, ſuſpect every new thing of Levity and Vanity, and contemn new Sects and new Opinions, as Maſks and Mummeries; judging it of little Significance, whether Men agree in their Theories *Suited to gain the Conſent of the Prudent.*

or

or not; only that the old ones, and such as are more current and received, are best fitted for Business, and conducting the Affairs of the World, on account of general Consent, and moral Considerations. Now there is no Remedy for this Inconvenience, but by the copiousness of the Example to strike so far into the Senses of Mankind, that any one of a tolerable Judgment, shall, at first sight, perceive the thing to be sober and solid, and pregnant with Usefulness, and Works; and immediately acknowledge it of a quite different Nature and Tendency from that of raising of a new School, or a new Sect.

Preserve a due Respect for the Ancients.

18. By this Means likewise, we are not without hopes to abolish, in some degree, that Authority and Confidence which Men have placed in the Ancients, and others; who introduce their own Opinions and Notions into Philosophy; at the same time that we preserve the Respect and Reverence due to them: and this not by any Artifice, but from the simple Force of the thing itself.

Shewing what Course the Ancients took in their Enquiries.

19. We farther conceive, our Method may lead Men to reflect, whether the Ancients have, themselves, made use of this kind of Diligence; and built their Doctrines and Opinions on sure Foundations. And indeed this might, to some, appear a Point of Debate; if only the Opinions of the Ancients had been handed down to us, without the least Intimation of their Method of Enquiry and Demonstration: for then we might be apt to suspect, that from the very first of their Contemplations, they had procured a large Stock of Examples; and disposed them in a similar, or perhaps a better order, than ourselves; and that they pronounced after a thorough Examination of the Matter; and at length set down their Determinations, with their Explanations and Corrections, in Writing; only adding here and there an Example or two, for the sake of Instruction; but judged it unnecessary and tedious, to publish their first Notes, rude Draughts, Hints, Journals, and Common-place-books: thus imitating Builders, who, after they have raised their Pile, take away the Scaffolding. But themselves will not suffer us to think thus of them; for they openly declare the Form and Manner they used in their Enquiries: and their Writings give us a clear and express Image of it. Their Method was, from certain Examples, most familiar to the Senses, to rise at once to the most general Conclusions, or Principles of the Sciences; and according to the fixed Truth hereof, to derive inferior Conclusions by Intermediates. And having once established this Art; if any Controversy afterwards arose, about an Example that seem'd to contradict their Principles, they rendered it conformable to them by Distinctions, or the application of their own Rules. Or if any mention was made of the Causes of particular Things; they ingeniously accommodated them to their own Speculations. And hence we have a distinct View both of the Thing itself, and the Error of their whole Procedure: for they plainly dismissed Experience too soon; and either neglected the intermediate Conclusions, which are the animating Souls of Works; or rested them upon a weak Foundation: and, what is not represented, substituted

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an illegitimate and unprosperous Subtilty of Wit, for Sense itself. And if at any time there is mention made in their Writings, of Examples and Particulars, these come too late; and after they had past Sentence, and fixed their Positions. But our Method is directly opposite to this; as will be abundantly manifest from the *Tables* themselves.

Setting all Men upon a level.

20. This therefore being the Case, we shall still leave the Ancients unrival'd, and in full Possession of all that Praise and Admiration which any one shall think their Due. And some of them were, doubtless, Men of an excellent Genius; which our Method has little Occasion for: since it puts the Capacities and Powers of Mankind nearly upon a Level. Thus, if a long, set Speech were to be delivered by Memory; a Man of a good Memory would have a great Advantage over another of a bad one; but if they were both to read their Speeches, the Difference in that case would be none at all. And thus it is in the Contemplation of things, which depends entirely upon the Powers of the Mind; where one Man infinitely excels another. But where the Enquiry is carried on by *Tables*, and a due Use and Application thereof; there is not much more Difference than we usually find in the Senses of Men. And indeed, we are afraid of a too great Subtilty and Agility of Genius in our Method; whilst Men are carried away with their own impetuous Motions: and would therefore add, not Wings, but Weights to their Capacities.

And making them follow Experience.

21. Nay, by Means of our *Tables*, we question not but to secure the most difficult Point of all; and bring it about, as it were, spontaneously, that after Mankind, (tho at the first Entrance it may seem somewhat difficult and strange) shall be a little accustomed to the natural Subtilty of Things exposed to their View; and become familiar with their Differences, plainly marked out in Experience, they shall soon look upon that Subtilty of Words and Disputes, which has hitherto employed and detained their Thoughts, but as a ludicrous thing, a kind of Charm, Infatuation, or Spectre; and pronounce of Nature, what is usually said of *Fortune*, that she has a Lock before, but none behind: as all that late and preposterous Subtilty of Dispute, coming after the time of Things is past, only catches at, but never lays hold of Nature.

To the perfecting of Enquiries.

22. We also judge ourselves here, to use a true, lively, and animated Form of Instruction: for we do not pluck the Sciences, like Flowers, from the Stalk; but deliver them over, Roots and all, that they may be transplanted, or new set, in better Genius's, as in a more fruitful Soil; that will bring them to greater Perfection. And for the Errors, Over-sights, Imperfections, and abrupt Breakings-off of our Enquiries, we, in our Method have this Advantage, that our Errors may easily be observed, and rejected, before they can deeply infect the Mass of Knowledge; that our Imperfections, and Defects may be readily supplied and corrected; and the Enquiries left unfinished, be continued under a successive Course of Additions and Improvements: and it is then that Men will know their own Strength, when infinite Numbers shall not do the same things over and over

again;

again; but ſome ſupply and finiſh, what others begun and left imperfect.

Giving Earneſt of Works.

23. We have alſo hopes, by this Method, to prevent the Retortings whereto our frequent mention of *Works* might have expoſed us, if we had not preſſed Mankind to converſe with Things themſelves: for Men cannot now well require thoſe Works from us, which we require from them; whilſt any one may eaſily perceive, that we do not barely talk about Works, becauſe the Tables themſelves contain ſome Draughts, Deſigns, and Earneſts of new Works; and, at the ſame time, plainly ſhew that our Scope is not, in the empirical manner, to derive Works from Works; but, like Interpreters of Nature, *Cauſes* from *Works*; and again, new *Works* from thoſe *Cauſes*. Thus avoiding an unſeaſonable and haſty turning aſide to Works, at the beginning; but obſerving, and waiting, the due and appointed time of the Harveſt.

And a Notion of the Extent of the whole Inſtauration.

24. In the laſt place, we hope alſo by this Means to poſſeſs Mankind of a juſt Opinion, not only of the Efficacy and Intention of our INSTAURATION; but alſo of the Bulk and Magnitude thereof: and thus prevent them from imagining that the Work we labour with, is an immenſe thing, beyond the Power of Mortals to effect; whereas it generally happens that the moſt uſeful Things are the leaſt voluminous. And tho the Enquiry into Nature we have here begun, may be too much for a few; it might prove a facile Work for a SOCIETY OF MEN. And with a View to ſhew this ſtill more clear and practicable, we ſhall here ſubjoin a *Catalogue of general Tables*, that may, perhaps, include the Whole.

A Catalogue of GENERAL TABLES; *for Enquiring into all the* WORKS *of* NATURE.

1. TAbles for the Enquiry of Motion.
2. Tables for the Enquiry of Heat and Cold.
3. Tables for enquiring into the Operations, Impreſſions, and Influence of Things at a diſtance.
4. Tables for enquiring into Vegetation, and Life of all kinds.
5. Tables for enquiring into the Actions and Paſſions of the Animal Body.
6. Tables for enquiring into the Senſes, and their Objects.
7. Tables for enquiring into the Affections of the Mind.
8. Tables for enquiring into the Mind and its Faculties.

And theſe Tables regard the Separation, or Diviſion of Nature, in point of Form; *but the following regard the Conſtruction of Nature in point of* Matter.

9. Tables of Enquiry into the Structure, or Architecture of the Univerſe.

10. Tables

10. Tables for enquiring into the great Relations, or Accidents, of Exiſtence.

11. Tables for enquiring into the Conſiſtences of Bodies, or their Inequality of Parts.

12. Tables for enquiring into *Species*, or the Fabrication, and common Aſſociations of Things.

13. Tables for enquiring into the leſſer *Relations*, or *Properties*, of Bodies[g].

And thus the *Univerſal Enquiry* may be comprehended in thirteen *General Tables*, with their Dependents or *leſſer Tables*; which are to be made occaſionally, or as immediate Uſe ſhall require: for we in no caſe proceed without our *Tables*, or *Papers*. As a Specimen, we will here annex that *Set of Tables*, required by our *Method* in the Caſe of *Motion*; which is a copious and diffuſive Subject.

A TABLE *for a Legitimate Enquiry into* MOTION.

1. The inferior Machine of the Underſtanding, or a Sequence of Tables upon the firſt View.

2. *Collective Tables*, exhibiting a Digeſt, or regular Series of Hiſtory to the firſt Article; to ſhew the Terms and Differences of Motion.

3. A Table of Motion by external Application; or *Motion of Adherence.*

4. A Table of Motion by internal Application; or the Motion of Mixture.

5. A Table of the Motion of Application to Fibres; or the Motion of Identity.

6. A Table of the Motion of Aſſimilation.

7. A Table of the Motion of Impreſſion; or Signature.

8. A Table of the Motion of Excitation.

9. Collective Tables of digeſted Hiſtory, to the ſecond Article.

10. A Table of the Subjects of Motion.

11. Collective Tables of regular Hiſtory to the third Article.

12. A Table of the Vehicles; or Conveyancers of Motion.

13. Collective Tables of regular Hiſtory to the fourth Article.

14. A Table of the Operations and Conſequences of Motion.

15. Collective Tables of regular Hiſtory to the fifth Article.

16. A Table of the Stages of Motion.

17. Collective Tables of regular Hiſtory to the ſixth Article.

18. A Table of the Sphere of Activity of Motion.

19. Collective Tables of regular Hiſtory to the ſeventh Article.

20. A Table of the Government and Regulation of Motion.

21. A Table of regular Hiſtory to the eighth Article.

22. A Table of the Aſſociations of Motions.

[g] What Additions, or Improvements, might be made to this *Catalogue*, for promoting the general Deſign thereof?

23. Collective Tables of regular Hiſtory to the ninth Article.
24. A Table of the Affinities, or Relations of Motion.
25. Collective Tables of regular Hiſtory to the tenth Article.
26. A Table of the uniting Powers in Motion.
27. Collective Tables of regular Hiſtory to the eleventh Article.
28. A Table of the Powers of Cuſtoms and Innovations in Motion.
29. Collective Tables of regular Hiſtory to the twelfth Article.
30. Tables of all the other Obſervables of Motion, not mentioned above.
31. A Table of Indications; or the primary Diſſection.
32. A Table of ſecondary Diviſion.
33. A Table of Obſervations; or imperfect Axioms.
34. A Table of apparent Impoſſibilities; or *Deſiderata* for human Uſes.
35. A Table of occaſional Uſes in active Life.
36. A Table of imperfect Interpretation.
37. Tables of Tranſportation, directing of new ones.
38. The *ſuperior Machine* of the Underſtandiug; or a Sequence of Tables upon a Review.
39. New Tables, for changing, diverſifying, or tranſpoſing the Enquiry [h].

For farther Illuſtration, take another Example of our *Tabular Method of Enquiry*, in a leſs general, tho copious Subject; the Affair of *Light* and *Splendor*.

A TABLE *of Enquiries for the particular* HISTORY *of* LIGHT *and* SPLENDOR.

1. IN the firſt place, draw up a Table of all thoſe Bodies of every kind, which afford Light: as, (1.) the Stars, fiery Meteors, Flame, Wood, Metals, and other ignited Bodies. (2.) Sugar, in ſcraping and breaking; Glow-worms; ſalt Water ſtruck and ſcattered abroad; the Eyes of certain Animals; rotten Wood; and large Tracts of Snow. Perhaps alſo the Air itſelf may have a feeble Light; adapted to the Eyes of ſuch Creatures as ſee by Night. (3.) Iron and Tin, when put to diſſolve in *Aqua fortis*, bubble and boil up, without the Aſſiſtance of Fire, and alſo conceive Heat; but whether

[h] This Draught of a *general Table* may appear ſomewhat unintelligible, unleſs the *inductive Method* of Enquiry, delivered in the *Novum Organum*, be previouſly underſtood. We do not find that the Author has any where proſecuted the Enquiry into Motion, according to this Model. The Table occurs among the poſthumous Pieces publiſhed in the *Scripta*; and was, no doubt, intended to be exemplifyed, illuſtrated, or filled up, after the ſame manner as the others of this *fourth Part*. But naked as it is, it has a capital Uſe; and ſhews the Way of working in the *Tabular Method*, ſo as to demonſtrate the whole Proceſs both of the Mind and Body, in conducting Enquiries: which is the End it is here propoſed to anſwer. Thoſe who require farther Inſtruction may conſult any of the other *Tables of Enquiry*, that are proſecuted; as, particularly, that prefixed to the *Hiſtory of Life and Death*; if the following one, for the Hiſtory of *Light and Splendor*, be not ſufficient. See alſo the *Novum Organum*, Part II. and the *Preliminary Diſcourſe* to the Abridgment of Mr. *Boyle*'s Philoſophical Works.

whether they afford any Light muſt be farther examined. (4.) The Oil of Lamps ſparkles in ſevere cold Weather; and a certain degree of Light has ſometimes been obſerved, in a clear Night, about a ſweating Horſe; and ſometimes alſo, tho rarely, about the Hair of Men's Heads, in the nature of a feeble, lambent Flame. A Woman's Stomacher has alſo been obſerved to ſhine upon rubbing; but as the Colour thereof was Green, and Alum is an Ingredient in that Dye, it was probably owing thereto; for it alſo crackled a little when it ſhone: but whether Alum in ſcraping, or pounding, affords Light, ſhould be farther examined; tho the Force applied to it for this Purpoſe, muſt, perhaps, be greater than that uſed to Sugar; it being a more ſtubborn Body. Some Stockings alſo have been obſerved to ſhine, in pulling them off; whether this proceeded from Sweat, or from Alum uſed in the Dye. Let all ſuch Inſtances be collected, and orderly diſpoſed into this firſt, or *Preſence Table*; to ſhew in what Subjects the thing we enquire after reſides.

2. In the next place, let a Table be formed of ſuch Bodies as yield no Light at all; and yet have a great Reſemblance with thoſe that do. Thus, boiling Water affords no Light; nor Air, tho violently heated. Looking-glaſſes and Diamonds [i], which reflect Light ſo very remarkably, yet yield none that is original, and their own; with other Inſtances of the like kind: and among them, let a diligent Enquiry be made after thoſe we call *Travelling Inſtances*; that is, where Light is preſent and abſent, tranſiently or by turns: thus an ignited Coal gives Light, yet if ſtrongly compreſſed it preſently ceaſes to be luminous: but the cryſtalline Matter of the Glow-worm, tho broken and divided into Parts, retains its Light for a ſmall time, tho it vaniſhes ſoon after. And this whole Collection of Inſtances, ranged in proper Order, will form what we call the *Abſence Table*; and exhibit all the Bodies wherein the Subject enquired after does not reſide; tho they nearly approach to thoſe wherein it does reſide.

3. Let it be next enquired, what Light is more, and what leſs intenſe and vibratory. Thus the Flame of Wood yields a ſtrong Light; the Flame of Spirit of Wine a weaker; and the Flame of Coals thoroughly ignited, yields a Light that is duſky, and ſcarce viſible. And the proper Inſtances of this kind, collected, will furniſh out what we call the *Degree Table*.

ARTICLE I.

The Colours of Light.

LET the Enquiry next proceed to the Colours of Light, to ſhew what they are; and what they are not. Some of the Stars are white, others ſhining; ſome reddiſh, and others livid. Common Flames, Corruſcations of the Air, and the Flame of Gun-powder, are principally whitiſh; but the Flame of

[i] Do not Diamonds, under certain Circumſtances, afford a Light in the dark? See *Boyle* and *Stahl*.

Sulphur beautifully blue. Some Bodies alſo yield purple Flames; but there have hitherto been diſcovered no green ones: tho the Light of the Glow-worm has a tendency thereto. Scarlet Flames alſo have not been obſerved: but ignited Iron is red; and when intenſely ignited, whitiſh. But all the Inſtances of this kind are to be collected, and thrown into a Table, to ſhew all the Variety of Colours in Light.

ARTICLE II.

The Reflections of Light.

1. LET it be next examined, what Bodies reflect Light: as Speculums, Water, poliſhed Metals, the Moon, and Gems. All fluid Bodies, and thoſe that have a very ſmooth and even Surface, afford ſome degree of Splendor; which is no other than a faint degree of Light.

2. It muſt be diligently examined, whether the Light of a lucid Body may be reflected by another that is lucid; as ſuppoſe ignited Iron were expoſed to the Sun's Rays: for Light is reflected again and again, from Speculum to Speculum, tho gradually fainter, and weaker.

ARTICLE III.

The Multiplications of Light.

1. LET the Enquiry next deſcend to the Multiplication of Light; as by Speculums, Teleſcopes, and the like, which have a Power to ſharpen Light, and throw it to a great diſtance; or elſe render it more ſubtile and better diſpoſed for diſtinguiſhing viſible Objects; as we ſee by the Practice of Jewellers, and other Artiſts, who ſet a ſpherical Glaſs of Water between the Candle and their Work.

2. It muſt likewiſe be examined, whether all Bodies, when in a large Quantity, do not reflect Light; for 'tis very probable that Light muſt paſs thro', or be reflected. And thus the Moon, tho it were an abſolutely opake Body, yet might, on account of its Magnitude, reflect Light. Let it likewiſe be examined, whether the Approximation of lucid Bodies does not multiply Light; which, in Bodies that are equally lucid alike, cannot be doubted: but whether the Light which is totally over-powered by a greater Light, ſo as of itſelf to be rendered inviſible, does not yet add ſome quantity of Light, muſt be farther examined. Even gloſſy Bodies contribute to the Increaſe of Light; for a Chamber hung with Silk, is lighter than when hung with Cloth. Light is alſo multiplied by Refraction; for Gems that are cut with Angles, and broken Glaſs, are more ſplendid than when plain, or entire.

ARTICLE IV.

The Ways of Drowning Light.

THE Methods of Drowning Light ſhould next be enquired into; as by the Predominancy of a greater Light, the Groſſneſs or Opacity of the Medium, *&c.* Thus, the Sun's Rays playing upon a culinary Fire, cauſes the Flame to appear as a certain white kind of Smoke. All the Inſtances of this kind ſhould be collected.

ARTICLE V.

The Operations, or Effects of Light.

THE Operations or Effects of Light, come next to be examined; tho they ſeem to be but few, and have little ſhare in bringing remarkable Changes upon Bodies, eſpecially thoſe that are ſolid: for Light, above all things, generates itſelf, and other Qualities, but ſparingly; however, it certainly attenuates the Air, is grateful, and chearing to the Spirits of Animals, excites the languiſhing Rays of Colours, and viſible Objects; for Colours are nothing more than the refracted Image of Light. But the Particulars of this kind are to be diligently hunted up, and collected.

ARTICLE VI.

The Continuance of Light.

THE Continuance of Light may be next examined, tho it ſeems to be but momentary; for notwithſtanding Light has continued in a Chamber many Hours, it illuminates the Chamber no more than it did the firſt Moment: but the Caſe is quite otherwiſe in Heat, *&c.* for the firſt Heat remains, and a new one is ſuperadded thereto. The Twilight is, by ſome, conceived to be the Remains of the Sun's Light.

ARTICLE VII.

The Directions, Motions, and Paſſages of Light.

THE Directions, Motions, and Paſſages of Light, ſhould be very attentively examined. Light is diffuſed all round; but whether at the ſame time it aſcends a little, or is equally diffuſed upwards and downwards,

muſt be enquired into. Light produces Light every where about it; ſo when the Body of a Taper is not perceived thro' the Interpoſition of a Blind, or Obſtacle, it ſtill illuminates all the Objects around it; excepting thoſe that are in the Shadow of the Veil. And yet even theſe Objects are ſomewhat illuminated by the Light thrown about them; for an Object ſtanding within this Shade, may ſtill be much better perceived than if no Light at all were preſent: and therefore the viſible Body of any luminous Matter, and Light itſelf, are two very different Things. Light does not penetrate fibrous Bodies, of an irregular and diſorderly Texture; tho it ſtill is not hindered by Solidity and Hardneſs; as we can ſee in Glaſs, *&c.* and therefore only ſtrait lined Bodies, whoſe Pores lie not tranſverſe, ſeem capable of tranſmitting Light.

Light is excellently tranſmitted thro' the Air; which the purer it is, the better the Light paſſes. But whether Light be convey'd by the Body of the Air, as Sounds are by the Winds, or in any other manner, ſhould be examin'd; with other Matters of the like kind, to complete this Article.

ARTICLE VII.

The Tranſparency of luminous and lucid Bodies.

IT ſhould next be examined, what lucid or luminous Bodies are Tranſparent. The Wiek of a Candle is perceived thro' the Flame; but Objects are not viſible thro' large Bodies of Flame. On the other hand, all Tranſparency is loſt in a Body upon Ignition; as appears in Glaſs. The Body of the Air is tranſparent; ſo is Water: but when theſe two tranſparent Bodies are mix'd together in Snow or Froth, they no longer preſerve their Tranſparency; but acquire a certain original Light.

ARTICLE VIII.

The Agreements and Diſagreements of Light.

THE Agreements and Diſagreements of Light muſt be enquir'd into. Light has a principal Correſpondence and Affinity with three Things, as to its Generation, *viz.* Heat, Subtilty, and Motion; the Conjunction and Separation whereof, in reſpect of Light, muſt therefore be examined, together with their Degrees. The Flame of Spirit of Wine, or the *Ignis fatuus*, is much milder in Heat, but ſtronger in Light than ignited Iron. Glow-worms, the dewy Vapor rais'd by the daſhing of Salt-water, and many other Things abovemention'd, yield Light, tho they are not warm to the Touch. Ignited Metals are not ſubtile Bodies; yet they have a burning Heat. On the contrary, Air is one of the ſubtileſt Bodies, yet has no Light. Again, Winds, tho very rapid in their Motion, afford no Light. Contrariwiſe, ignited Metals have but a dull and languid Motion, yet vibrate Light.

But

But there is nothing ſo nearly related to Light, not indeed with regard to its Generation, but only to its Paſſage, as Sound; and therefore their agreements and diſagreements are to be diligently ſought. Some of their Agreements are theſe. (1.) They both diffuſe themſelves in a Sphere, (2.) They both move to very great Diſtances; but Light the ſwifteſt; as appears in the diſcharging of Cannon, where the Light is firſt perceiv'd before the Sound, and the Flame follows after. (3.) They have both very *ſubtile Differences*; Sounds in the Articulation of Words, and Light in all the Images of viſible Things. (4.) They both produce or generate little; except in Senſes and Spirits of Animals. (5.) They both are eaſily generated, and ſoon vaniſh. (6.) Light is drowned by a greater Light; and Sound by a greater Sound, *&c.*

Some of their Differences are theſe. (1.) Light moves ſwifter than Sound. (2.) Light moves farther than Sound; (3.) Light moves only in a ſtrait Line; but Sound obliquely and every other way. For when an Object is perceived in the ſhade of an Obſtacle, 'tis not becauſe the Light penetrates the Obſtacle, but only illuminates the Air round about; whence the Air behind the Obſtacle is alſo ſomewhat illuminated. But a Sound begun on one ſide of a Wall, is heard without much Diminution on the other. And again, Sound is heard from withinſide a ſolid Body, as in the Eagle-ſtone, or from Bodies ſtruck under Water: But Light is not at all perceived in a tranſparent Body, that is every way obſtructed or ſurrounded. (4.) Laſtly, all Sound is generated in Motion, and a manifeſt ſtroke of the ſounding Body; which in Light is otherwiſe.

But for the Diſagreements of Light, there have been none hitherto obſerved, unleſs Privations may be call'd Diſagreements. And it ſhould ſeem that ſluggiſhneſs in the Parts of Bodies is the greateſt Enemy to Light; for ſcarce any Thing is luminous that is not in its own Nature remarkably moveable; or eaſily excited, either by Heat, Motion, or vital Spirit: but this Enquiry ſhould be further proſecuted. And we always mean, not only that other new Inſtances ſhould be diligently ſought out, in Conformity with thoſe few which we only produce as a Specimen; but likewiſe that new Articles, and Tables of Enquiry, ſhould be ſet down, added, and drawn up as the Nature of the Subject directs or requires [1].

THE

[1] This Subject of *Light* is proſecuted to a conſiderable length by Dr. *Hook*, in his *Lectures of Light*; by Mr. *Boyle*, in his *Experiments and Obſervations upon Colours*; M. *Huygens de la Lumiere*; and ſince by Sir *Iſaac Newton*, in his *Treatiſe of the Reflections, Refractions, Inflections, and Colours of Light*.

29 MR 64

THE HISTORY OF LIFE and DEATH.

THE HISTORY OF LIFE AND DEATH.

BRITISH MUSEUM

A

DELINEATION

OF THE

PARTICULAR HISTORY

OF

LIFE and *DEATH*;

With a View to

PRESERVE HEALTH,

RETARD OLD-AGE;

AND

Lengthen the preſent Period

OF

HUMAN LIFE.

PREFACE.

THE Subject of human Life and Death is, of all natural Subjects, the moſt intereſting to Men; and, as ſuch, the Author has treated it with uncommon Diligence. The Enquiry is conducted in the inductive Method; and carried to a conſiderable Length: with Directions for continuing it ſtill farther, till we arrive at a Knowledge of the Cauſe *and* Form *of Life and of Death. The whole being left in ſuch forwardneſs, it may naturally be asked why it has not been ſince brought nearer to Perfection? The principal Reaſon I can aſſign is, that Phyſicians have been otherwiſe employ'd: and Men of different Profeſſions ſeem diſcouraged from improving an Art they do not practiſe. The Diſeaſe is eaſier found than the Remedy. Nor can a capital Remedy, in this Caſe, be expected till Men ſhall, in ſome degree, have conquer'd their Paſſions; and ſhew a leſs regard to private, and a greater to publick Good. The Author, has ſhewn by an illuſtrious Example, that Perſons of a publick Spirit, might, tho they were not bred to Phyſick, treat the Subject of Life and Death to Advantage.*

That the full Scope and Conduct of the Piece may be underſtood, it will be proper to remember the Doctrine laid down in the ſecond Part of the Author's Novum Organum; *concerning the Method of proſecuting Enquiries.*

INTRO-

PREFACE.

THE Subject of human Life and Death is, of all natural Subjects, the most interesting to Men; and, as such, the Author has treated it with uncommon Diligence. The Enquiry is conducted in the inductive Method; and carried to a considerable Length: with Directions for continuing it still further, till we arrive at a Knowledge of the Cause and Form of Life and of Death. The whole being left in such Forwardness, it may naturally be asked why it has not been brought nearer to Perfection? The principal Reason I can assign is, that Philosophers have seldom employed [illegible] and Men of different Professions seem disinclined from interesting [illegible] they do not practise. The Disciple is [illegible] the Remedy. Nor can a capital Remedy, in this Case, be expected from Men [illegible], in some degree, have conquered their Passions; and those a little regard to private, and a greater to public Good. The Author, has proven by an illustrious Example, that Persons of a public Spirit, might, who they were not bred to Physick, treat the Subject of Life and Death to Advantage.

That the full Scope and Conduct of the Piece may be understood, it will be proper to remember the Definitions laid down in the second Part of the Author's *Novum Organum*; concerning the Method of prosecuting Enquiries.

29 MR 64

INTRO-

INTRODUCTION.

THE Shortneſs of Life, and the ſlow Advancement of Arts, has been an ancient Complaint. 'Tis therefore agreeable to our Deſign of beſtowing the utmoſt Pains upon the perfecting of Arts, to conſider alſo the Ways of prolonging human Life. But this Enquiry is preſſed with Difficulties; the rather, becauſe of falſe Notions and Opinions concerning it: for what the Phyſicians have frequently in their Mouths, about radical Moiſture, and natural Heat, are but deluſory Conceits; and the extravagant Commendations of chemical Medicines, do but firſt ſwell up, and then diſappoint our Hopes [a].

The preſent *Enquiry* is not directed to that kind of *Death* which proceeds from Suffocation, Putrefaction, and Diſeaſes; for this belongs to *Medicinal Hiſtory* [b]: but to that Death only, which comes on by Reſolution, and a Waſting of the Parts, thro' Old-Age. The laſt Step, indeed, of *Death*, or the total Extinction of Life, (which may happen ſo many Ways, both external and internal; tho they have all of them, as 'twere, one common Avenue at laſt,) has ſome relation to our Deſign: and brings up the Rear of the *Enquiry*.

Whatever may be gradually repaired, without Deſtruction to the original Whole, is, like the *Veſtal* Fire, potentially eternal: whence Phyſicians and Philoſophers, obſerving that Animals are totally nouriſhed, and their Bodies recruited and ſupplied, tho not for any long Continuance; but ſoon after grow old, and haſten to a Diſſolution; they have ſought for *Death* in a Subject not properly capable of Repair: and judged, that a certain radical, and primitive Moiſture, could not be totally recruited; but that there was a certain ſpurious Appoſition of Parts, and not a juſt Repair, carried on from Infancy, and gradually degenerating with Age; till, at length, this Depravity ends in Non-exiſtence.

This is but a crude and flaſhy Notion; for all the Parts of an Animal in youth, and in a growing State, are totally repaired; and, for a time, not only improved in Quality, but augmented in Quantity: inſomuch that the recruiting Matter might be, in ſome meaſure eternal, if the Manner of Recruiting did not fail. But here lies the Caſe, that in declining Age, the Repair is made very unequally; ſome Parts being ſucceſsfully nouriſhed, but

[a] The Virtues of Pharmaceutical Preparations are ſo unſettled, that 'tis generally little more than Levity, to extol or decry particular Remedies.

[b] See the *Introduction* to the *Sylva Sylvarum*, pag. 24, 25. of this Volume.

but others with difficulty, and for the worſe: ſo that from this time, animal Bodies begin to ſuffer the *Mezentian* Torment, of having the live Parts die in the Embraces of the dead ones; thoſe that are eaſily reparable failing, thro' their Conjunction with ſuch as are not: for when Age is upon the Decline; the Spirit, the Blood, the Fleſh, and the Fat, are eaſily repaired; but the dryer, or more ſpongy Parts; the Membranes, the Coats, the Nerves, the Arteries, the Veins, the Bones, the Cartilages, moſt of the *Viſcera*, and nearly all the organical Parts, are repaired with Difficulty, and Loſs.

And as theſe Parts muſt of Neceſſity officiate in the actual Repair of the more reparable Parts; but, being thus diminiſhed in their Activity and Powers, can no longer perform their Functions; it follows, that all of them ſoon begin to languiſh; and the Parts, in their own Nature moſt reparable, now wanting the ſervice of the Organs of Repair, can no longer be commodiouſly ſupplied; but impoveriſh by degrees, and at length totally fail.

The *Cauſe* of this Revolution lies here, that the Spirit, like a gentle Flame, is perpetually preying upon the Parts [c]; and in Conjuction with the external Air, which alſo drinks and dries up tangible Bodies, at length deſtroys the Work-ſhop of the Body, its Inſtruments and Machines; and thus renders them unfit for performing their Office. And this is the true Proceſs of *natural Death*; which requires to be thorowly conſidered: for *he who knows not the Ways and Courſes of Nature, can never oppoſe and bend her* [d].

This *Enquiry*, therefore, conſiſts of two Parts; with reſpect, (1.) to the Conſumption or Depredation of the Body; and, (2.) to its Repair, or Recruit: with a View, as much as poſſible, to prevent the former and promote the latter. The *firſt* has a principal Regard to the Spirit, and external Air, which make the Depredation; and the *ſecond*, to the entire Proceſs of Alimentation, which ſupplies the Repair.

The *Enquiry of the Conſumption* has many Things in common with inanimate Bodies: for the Effects which the innate Spirit, reſiding in all tangible Subſtances, whether animate or inanimate, and which the external Air produces upon inanimate Bodies, are likewiſe endeavoured upon animate Bodies: whilſt the Interpoſition of the vital Spirit, on one ſide, checks and reſtrains their Operations; and, on the other, powerfully promotes them. For 'tis plain, that many inanimate Bodies may endure a long time without Repair; whereas animate Bodies preſently fail, without Nouriſhment and Recruit; thus, like Fire, becoming extinct.

Our *Enquiry* therefore muſt be double; and regard firſt the human Body, as a thing inanimate and unſupported by Aliment; and ſecondly, as a thing animate and nouriſhed [e].

And

[c] Let this Conſideration, of the Spirits preying upon the other Parts, be duly regarded: it is of great Importance to what follows. See *Sect.* I. 13, 14.

[d] As it is neceſſary he ſhould do, who would endeavour to lengthen the preſent Period of Human Life.

[e] Obſerve the Sagacity and Judgment in diſtinguiſhing and fixing the two capital Points of the Enquiry.

And this *Enquiry*, we hope, might redound to a general good; if Phyſicians would but exert themſelves, and raiſe their Minds above the ſordid Conſiderations of Cure: not deriving their Honour from the Neceſſities of Mankind; but becoming Miniſters to the divine Power and Goodneſs, both in prolonging and reſtoring the Life of Man: eſpecially as this may be effected by ſafe, commodious, and not illiberal Means; tho hitherto unattempted[d]. And certainly it would be an Earneſt of the divine Favour, if, whilſt we are journying to the *Land of Promiſe*, our Garments, theſe frail Bodies of ours, were not greatly to wear out in the Wilderneſs of this World.

SECT. I.[e]

The General TABLE *of* ENQUIRY; *or a Set of Heads for the* particular HISTORY *of* Human Life and Death; *with Directions for the Conduct of the whole.*

ARTICLE I.

A Previous Enquiry into the Nature of Durability; and its Degrees, in inanimate and vegetable Bodies.

This Article to be proſecuted, not at large, or in due form; but conciſely, by certain Heads; and as in Paſſage[f].

ARTICLE II.

OF Dryneſs, Arefaction, and the Conſumption of inanimate Bodies and Vegetables; with the Manner and Proceſs they ſucceed in, and the Ways of preventing and retarding all three: the preſerving of

[d] See hereafter, *Sect.* VIII.

[e] It may be proper to obſerve at the Entrance of this Piece, that each *Section* is what the Author underſtands by a *Table*, which is formed at many different Operations of the Mind, in the way of ſo many *Steps*; whence the whole Enquiry being artificially broke into a number of diſtinct and commodiouſly manageable Parts, the Mind both at firſt, and ever afterwards, operates with the greater Eaſe, Freedom, and Advantage. For thus every *Table* is a ſeparate Work, not finiſhed; but left ſtill open to receive farther Additions and Improvements. And when all the *Tables* ſhall be perfected, then, and not till then, will the whole Enquiry be finiſhed. So that the Underſtanding has many more Steps to take, before it arrives at a plenary Knowledge of the *Form* of *Life and Death*. This Advertiſement may be leſs neceſſary to thoſe who are verſed in the Author's Method of Enquiry, laid down and exemplified in the ſecond Part of his *Novum Organum*.

[f] The Directions, occaſionally ſubjoined to theſe Articles of Enquiry, were not only intended to regulate the Conduct of the Author; but, likewiſe, the Conduct of all future Enquirers into the ſame Subject.

Bodies in their own State; and laſtly, a more careful Enquiry *into the Ways of ſoftening, mollifying, malaxing, and recovering of Bodies after they once begin to be dried.*

Nor is a perfect, rigorous *Enquiry* neceſſary under this Article; both as theſe Particulars may be deduced from their proper Head of *Durability*, and are not capital Things to the preſent Purpoſe; tho they afford Light to the Way of prolonging and reſtoring Life in Animals.

From inanimate and vegetable Bodies, let the Enquiry deſcend to Animals, excluſive of Man.

ARTICLE III.

OF the Long and Short Life of Animals; with the proper Circumſtances which ſeem to have a Share in the Difference.

ARTICLE IV.

AS the Duration *of Bodies is of two kinds; the one conſiſting in ſimple Identity, the other in Repair; the firſt whereof obtains only in Bodies inanimate; the ſecond, in Vegetables and Animals, and is performed by Alimentation; the next ſtep of the Enquiry muſt be, into the* Buſineſs of Alimentation, with its Ways and Proceſs.

Neither is Exactneſs required here; becauſe this belongs to the Heads of *Aſſimilation* and *Alimentation:* and need only be touched, as the former, in Paſſage.

The Enquiry muſt next deſcend to *Man:* and as this is the principal Subject of all, the Procedure ſhould be here, in every reſpect, exact and perfect.

ARTICLE V.

AN Enquiry into the Length and Shortneſs of Life in Men, according to the different Ages of the World, Countries, Climates, Places of Nativity, and Habitation.

ARTICLE VI.

OF the Length and Shortneſs of Life in Men, with regard to their Origin and Propagation, as it were in an Hereditary Manner; alſo with regard to their Complexions, Conſtitutions, Habits of Body, Stature, manner and periods of Growth, and the formation and knitting of the Limbs.

ARTI-

ARTICLE VII.

OF the Length and Shortneſs of Life in Men, according to the Times of their Nativity: this Enquiry being ſo conducted, as at preſent to drop all aſtrological and horoſcopical Conſiderations; and receive only the more manifeſt and common Obſervations, if there be any; ſuch as Birth in the ſeventh, eighth, ninth, and tenth Month, happening by Night or by Day, or in different Months of the Year.

ARTICLE VIII.

OF the Length and Shortneſs of Life in Men, with regard to their Food, Diet, manner of Living, Exerciſe, &c. *the Conſiderations of the Air which Men breathe, belonging to the fifth Article, under the Head of Habitation.*

ARTICLE IX.

OF the Length and Shortneſs of Life in Men, with regard to their Studies, kinds of Life, Paſſions of Mind, and various Accidents.

ARTICLE X.

A Separate Enquiry *into ſuch Remedies as are thought to prolong Life.*

ARTICLE XI.

OF the Signs and Prognoſticks of long and ſhort Life: not ſuch as denote Death at hand; which belong to medicinal Hiſtory; *but ſuch as appear, and are obſerved, even in Health; whether derived from Phyſiognomy, or other Conſiderations.*

Thus far the Enquiry proceeds upon the Length and Shortneſs of Life, in an artleſs and miſcellaneous manner: whereto 'tis proper to add an *artificial Enquiry*, tending to Practice, by three *general Intentions*. We ſhall lay down the more particular Diſtributions of theſe *Intentions* when we come to the *Enquiry* itſelf[z]. Let it only be obſerved for the preſent, that theſe three *general Intentions* are, the *Prevention of Waſte*, the *Perfecting of Recruit*, and the *Renovation of Decay*.

[z] See hereafter, *Sect.* VIII.

ARTICLE XII.

AN Enquiry into thoſe Things which preſerve and exempt the human Body from Arefaction and Conſumption; or at leaſt retard and ward off the Tendency thereto.

ARTICLE XIII.

AN Enquiry into the Particulars belonging to the entire Proceſs of Alimentation; whereby the Body of Man is recruited, in order to its Perfection, and the Prevention of Loſs.

ARTICLE XIV.

OF the Things which diſcharge the worn-out Materials; ſupply new ones; and ſupple and moiſten the Parts that are dried and indurated.

But as 'tis difficult to know the Ways of Death, before its Seat is diſcovered, this alſo muſt be enquired into; tho not with regard to all kinds of Death; but ſuch only as proceed, not from Violence, but from Privation, and want of Supply: for this kind alone belongs to the Waſting of the Body by Age.

ARTICLE XV.

AN Enquiry into the Point of Death, *and the Avenues leading up to it, on all Sides; thro' want of Supply, and not thro' Violence.*

And as it is proper to underſtand the *Characteriſtick* and *Form of Old Age*, this *Enquiry* muſt not be omitted; and is beſt made by diligently collecting, and comparing together, all the Differences in the State and Functions of the Body, happening betwixt Youth and Old Age; which, at length, will ſhew what the Thing is that ſhoots out into ſo many Effects.

ARTICLE XVI.

A Careful Enquiry into the different States of the Body, in Youth and Old Age; obſerving if there be any thing that remains the ſame unimpaired in Age [h].

SECT.

[h] Here the Author ends his own Enquiry; leaving every Article open to receive the Improvements of others: only, in his uſual manner, endeavouring to raiſe a Set of AXIOMS and CANONS, upon what is already diſcovered, in the way of Firſt-fruits, and Earneſts of greater Things.

SECT. II.

The History of Durability; with regard to the first Article of the Table of Enquiry [k].

1. METALS are so lasting, that the Observation of Mankind is not sufficient to fix the time of their Duration: even when resolved by Age, they are but turn'd to Rust, without loss of Parts; tho Gold suffers neither of these Changes [l]. *The durability of Bodies inanimate, viz. Metals.*

2. Quicksilver, tho a Fluid, and extremely volatile in the Fire, is not known either to waste or rust by Age alone, without Heat. *Quicksilver.*

3. Stones, especially the harder Kinds, and many other Fossils, are exceeding durable; even tho exposed to the open Air; much more when buried under Ground. Stones, however, gather a kind of Nitre [m], after the manner of Rust: but Gems and Crystals are more durable than Metals; tho they lose somewhat of their Splendor with great Length of Time. *Stones.*

4. 'Tis observed, that Stones are sooner consumed on the side exposed to the North, than on that exposed to the South; as appears plainly in Pyramids, Temples, and other Buildings: whilst Iron, on the other hand, rusts faster on the side exposed to the South than to the North; as we find by the Iron Bars of Windows: and no wonder; since in all Putrefactions, and Rust is one, Moisture promotes the Dissolution, as Dryness does in simple Arefaction.

5. Vegetables severed from the Earth, and the Trunks of the harder Trees, Timbers, &c. endure for some Ages [n]. But the parts of the Trunk are different; some Trees being fistulous, as the Alder, where the Pith in the middle is soft, and the external part hard: but in Timber Trees, as the Oak, the inner part, call'd the Heart of the Tree, is most durable. *Vegetables.*

6. The Leaves, Flowers, and even Stalks of Plants are of small Duration; and either putrefy or resolve to Dust and Ashes: the Roots being the more durable Parts.

7. The Bones of Animals last long; as we see in Charnel Houses. Horns and Teeth are very durable; as appears in Ivory, and the Tooth of the Sea-Horse. *Animal Substances.*

8. Skins,

[k] See pag. 337.

[l] Unless its proper Menstruum, the Fumes or Spirit of Sea Salt, happen to meet with it. Remark all along the Author's Method of proceeding by Induction; or a Collection of Facts, Observations and Experiments; which when duly tabled, as so many *Data*, give the *Quæsita*.

[m] I suppose this is meant of the *Nitrum Murale*.

[n] There are certain Trees, which in a very few Years turn to Moss, or mould, by lying buried in the Ground. See Mr. *Evelyn's Sylva*, and the *Philosophical Transactions*.

8. Skins, Hides, and Leather are alſo durable; as appeats from the ancient Manuſcripts on Vellum, *&c.* Paper alſo will laſt many Ages; tho it is leſs durable than Parchment.

Bodies that have paſs'd the Fire.

9. Bodies by paſſing the Fire are render'd more durable; as Glaſs, Bricks, *&c.* Even Fleſh and Fruits that have felt the Fire, prove more durable than when crude: not only becauſe the Fire prevents Putrefaction, but becauſe when the aqueous Moiſture is gone, the unctuous Moiſture ſupports itſelf the longer.

Water and Oil.

10. Of all Liquors, Water is ſooneſt abſorbed by the Air; but Oil, on the contrary, exhales ſlowly, as appears both in the Liquors themſelves, and again when mix'd with other Bodies: for Paper dip'd in Water, acquires ſome degree of Tranſparency, but ſoon loſes it again, and turns white, thro' the Exhalation of the Water; whereas Paper dip'd in Oil, long remains tranſparent, becauſe the Oil does not exhale.

Gums.

11. All Gums are exceeding durable; ſo likewiſe is Wax and Honey.

An uniform ſtate requiſite to durability.

12. But equability and inequability in the accidental Circumſtances of Bodies have as great a ſhare in the duration or deſtruction of them as Things themſelves: for Timber, Stones, *&c.* lying continually either in Water or in Air, laſt longer than if they were ſometimes removed from the one to the other. So Stones, laid in Buildings with the ſame Direction, as to the Points of the Compaſs, they had in the Quarry, prove more durable than they otherwiſe would; and the Caſe is the ſame in removing of Plants *o*.

Two larger Obſervations.

Two capital Obſervations with regard to the Spirits in Bodies.

13. Let it be held as certain, that there is in all tangible Bodies a Spirit, or pneumatical Subſtance, envelloped and included in the tangible Parts; and that this Spirit is the Origin of all Diſſolution and Conſumption; which are therefore to be prevented by the detention of this Spirit.

14. This Spirit is detain'd two ways; either by cloſe Compreſſion and Confinement, or by a kind of ſpontaneous Reſidence. And this Lodgment is ſollicited two ways; *viz.* if the Spirit itſelf be not very moveable or ſharp; and again, if it be not excited by the external Air to deſert. So that there are two durable Subſtances, a hard one and an oily: the firſt conſtringes the Spirit, and the ſecond in ſome meaſure appeaſes it; and is leſs ſollicited by the Air, for Air is of the ſame Subſtance with Water; and Flame with Oil *p*.

The Duration of Plants. The Cold.

And ſo much for the Nature of *Durability* in Bodies inanimate.

15. The Plants accounted cold, are annual, and die yearly, both in their Root and Stalk; as Lettuce, Purſlane, Wheat, and all Kinds of Grain: yet there are ſome cold Plants which laſt for three or four Years; as the Violet, Strawberry, Pimpernel, Primroſe and Sorrel; but Borage and Bugloſs, tho ſo like when alive, differ in death: for Borage is but annual; whereas Bugloſs laſts longer than one Year. 16. Nume-

o Is this ſufficiently verified?

p Let the juſtneſs of theſe *larger Obſervations*, and their importance, be thoroughly perceived.

16. Numerous hot Plants bear Age well; as Hyſſop, Thyme, Savory, common Marjoram, Baulm, Wormwood, Germander, Sage, *&c.* but Fennel dies yearly in its Stalk, and ſhoots again from the Root: whereas Baſil and ſweet Marjoram endure Age better than they do the Winter; for when planted in a warm and well fenced place, they flouriſh above one Year: and a Bed of Hyſſop, clipt every ſix Months, has been known to continue forty Years. *The Hot.*

17. Shrubs and Buſhes continue flouriſhing for ſixty Years, and ſome for twice that time. The Vine may live to ſixty, and be fruitful even to the laſt. Roſemary well ſecured, will likewiſe reach to ſixty; and Bear's-foot, and Ivy to more than a hundred. The Age of the Bramble cannot be well computed; becauſe bending to the Earth, it ſtrikes freſh Roots; ſo that 'tis hard to diſtinguiſh the new Shoot from the old. *The duration of Shrubs.*

18. Among large Trees the longeſt lived are the Oak, the Holm, the Aſh, the Elm, the Beech, the Plane, the Fig, the Lote, the Olive, the wild Olive, the Palm and the Mulberry: ſome of theſe will laſt eight hundred Years; and the ſhorteſt Livers of them all, two hundred. *Of large Trees.*

19. But odoriferous and reſinous Trees are in their Matter or Wood ſtill more durable. 'Tis true, the Cypreſs, the Fir, the Pine, the Box, and the Juniper, are ſhorter Livers; but the Cedar, aſſiſted by the bulk of its Body, nearly equals the abovementioned. *The odoriferous and reſinous kind.*

20. The Aſh, briſk and quick in its Growth, lives to a hundred Years or more; ſo likewiſe do the Birch, the Maple, and the Service-Tree: but the Poplar, the Lime, the Sycamore and the Walnut are not ſo long lived. *The Aſh, &c.*

21. The Apple, the Pear, the Plumb, the Pomegranate, the Citron, the Lemon, the Medlar, the Cornel, and the Cherry-tree, may laſt fifty or ſixty Years; eſpecially if now and then ſcoured of their Moſs, which ſurrounds ſome of them. *Fruit Trees.*

22. In general, Largeneſs of bulk in Trees, where other Things are equal, has ſome Affinity with their Continuance of Life; ſo likewiſe has hardneſs of Subſtance: and ſuch as bear Maſt and Nuts are generally longer lived than Fruit-trees. So again, thoſe that are late, either in Fruit or Leaf, and alſo ſhed late, are longer lived than ſuch as bear and ſhed early: So wild Trees, are longer lived than thoſe of the Orchard; and of the ſame kind ſuch as bear an acid Fruit live longer than ſuch as bear a ſweet one. *Largeneſs has ſome relation to durability.*

A larger Obſervation.

23. *Ariſtotle* has excellently obſerved the difference between *Plants* and *Animals*, in point of Nouriſhment and Recruit, *viz.* that the Bodies of Animals remain confined within their own Bounds; ſo that when come to a due magnitude, they are ſupported and preſerved by their Aliment, without the new growth of any thing but Hair and Nails, which are accounted excrementitious; whence of neceſſity the Juices of Animals ſooner grow old: whereas Trees often put out new Branches, new Shoots, new Leaves, new *A Capital Obſervation of the difference betwixt the nouriſhment of Plants and Animals.*

Fruits ; whence alſo, the other parts become new, and feel not the effects of Age ; becauſe whatever is green and young, more briskly and ſtrongly attracts the Nouriſhment to itſelf, than what has begun to grow dry ; inſomuch that the Trunk itſelf, thro' which the Sap is conveyed to the Branches, thus comes to be watered, and ſupplied with a more rich and plentiful Aliment [q]: as remarkably appears from hence, that in the cutting of Hedges, the lopping of Trees, and the thinning of Coppices, the Stem or Trunk is always invigorated, and render'd much longer lived by the loſs of its Shoots, or Branches.

SECT. III.

The Hiſtory of Deſiccation, the prevention thereof, and the ſoftning of dry'd Bodies : with regard to the ſecond Article of the Table of Enquiry.

Deſiccation by Fire. FIRE, or intenſe Heat, drys ſome Bodies, and melts others : it drys Earth, Stone, Wood, Cloth, Hides, and all Bodies uncapable of melting ; but fuſes Metals, Wax, Gums, Fat, *&c.*

2. Even thoſe Things that melt in the Fire are dry'd by it at laſt ; if the Fire be increaſed. Thus Metals, with a violent Heat loſe their volatile Part ; and all of them, except Gold, become lighter and more brittle [r] : and by a ſtrong Fire, oily and fat Bodies, become ſcorched, dry and cruſty.

By Air. 3. The open Air is manifeſtly drying, but never melting ; thus the Surface of the Earth is dried after being wet with Showers ; ſo Linnen is dry'd after waſhing, by expoſing it to the Air ; and Herbs, Leaves and Flowers are dry'd in the Shade, *&c.* but the Air performs this much more powerfully, when aſſiſted by the Sun's Rays, or put into Motion, as by Winds, *&c.*

Age. 4. Age has a great, tho an exceeding ſlow power of drying, as we ſee in all Bodies ; which, unleſs prevented by Putrefaction [s], grow dry with Age : yet Age is nothing of itſelf ; or no more than the meaſure of Time : but the Effect is produced by the native Spirit of Bodies, which drinks up their Moiſture, and flys off together with it ; whilſt the external Air multiplies

[q] Whence in effect, the Trunk becomes continually young again. This Obſervation, therefore, is of great importance to the preſent Enquiry ; as it may in ſome degree be transfer'd from vegetable to animal Subjects ; and afford a Rule for procuring a kind of Rejuveneſcency ; as by the uſe of Frictions, *&c.* on the external Parts of the Body, ſo as to perſpire the old Juices ; and cauſe thoſe Parts more ſtrongly to attract new ones.

[r] Even Gold itſelf loſes of its weight, and becomes a purple Glaſs, when expoſed to the Focus of a large Lens, or burning Concave. See M. *Homberg*'s Paper upon the Subject. *Memoir. de l' Acad*, An. 1702.

[s] Do not all Bodies after compleat Putrefaction, become dry and truly terreſtrial ?

multiplies itſelf thereon, and preys upon the native Spirit and Juices of Bodies [t].

5. But Cold is, properly, the greateſt Dryer of all: for there can be no Dryneſs without Contraction, which is the proper Effect of Cold. But as we have a powerful degree of Heat in Fire, and only a very feeble one of Cold, as that of the Winter, Snow, Ice, *&c.* the Arefactions of Cold are but weak on the Earth, and eaſily deſtroy'd; yet we find the face of the Earth more dry'd by Froſt, and *March* Winds, than by the Sun; whilſt the ſame Wind that licks up the Moiſture produces Cold [v]. *Cold.*

6. The Smoak of Fire gives Dryneſs, as we ſee in the caſe of Fleſh ſuſpended in Chimnies; and ſo the fumigations of Frankincenſe, *Lignum Aloes*, &c. dry the Brain, and ſtop Defluxions. *Smoak.*

7. Salt by continuance drys, not only externally, but deeply; as appears in the ſalting of Fleſh or Fiſh; which lying long in the Salt are manifeſtly hardened, even internally. *Salt.*

8. Hot Gums applied to the Skin, dry and wrinkle it; ſo likewiſe do ſome aſtringent Liquors. *Gums.*

9. High rectified Spirit of Wine drys almoſt like Fire; ſo far as to harden and blanch the white of an Egg put into it, and almoſt to ſcorch up Bread. *Spirit of Wine,*

10. Powders dry like Spunges, by ſucking up Moiſture; as we ſee in throwing Sand upon freſh writing. Even a Poliſh, or the cloſe union of a Body, not permitting a moiſt Vapour to enter its Pores, drys by accident; as expoſing the Subject to the Air. Thus Gems, Looking-glaſſes and Sword-blades, when breathed upon, appear at firſt cover'd over with a Vapour, which preſently vaniſhes like a light Cloud. And ſo much for the Article of *Deſiccation*. *and Powders.*

11. In the Eaſtern Parts of *Germany* they make uſe of ſubterraneous Granaries, for preſerving their Corn, by laying Straw at the bottom, and all around to ſome height, in order to repel and ſuck up the humidity of the Cave; by which means they keep their Grain for twenty or thirty Years not only uncorrupted, but, what makes to the preſent Enquiry, in ſuch a ſtate of freſhneſs, as excellently fits it for the making of Bread. And the like Practice, 'tis ſaid, has formerly prevail'd in *Cappadocia*, *Thrace*, and ſome parts of *Spain*. *Prevention of Deſiccation inſtanced in ſubterraneous Granaries.*

12. Granaries are commodiouſly made in Garrets, or upper Rooms, with Windows open to the Eaſt and North: and ſome have two Floors, an upper and a lower for this purpoſe; the upper one being perforated, that the Grain may continually fall thro' the Holes thereof, like Sand in an Hour-glaſs,

[t] This might paſs for a *larger Obſervation*, of capital Import.

[v] A freezing degree of Cold even drys up Water; or turns it from a Fluid into a Solid. And a ſtill greater degree will congeal Wine, Brandy, Oil of Vitriol, and other mineral acid Spirits: a ſtill higher might congeal Quickſilver itſelf; tho this was never experienced in the utmoſt degrees of Cold that Men have hitherto been able to produce; not even by the mixture of Spirit of Nitre and Ice.

glaſs, and ſome Days after be again thrown back with Shovels; ſo as to keep the Grain in continual Motion: by which Contrivance, Corruption is not only prevented, but Freſhneſs preſerved, and Dryneſs retarded; the *Cauſe* whereof, as we intimated above [u], is the diſcharge of the aqueous Moiſture, which being accelerated by the Motion of the Wind, preſerves the oily Moiſture in its ſtate, that wou'd otherwiſe fly off along with the aqueous. And thus on certain Mountains, where the Air is pure, dead Corps will remain many Days unfaded.

13. Fruits, as Apples, Pears, Lemmons, *&c.* and Flowers, as Roſes, Lillies, *&c.* may be long kept freſh in cloſe ſtopt earthen Veſſels; tho indeed the Air from without is ſomewhat prejudicial, by communicating its Inequalities thro' the Veſſel; as manifeſtly appears in the caſe of Cold and Heat: ſo that if the Veſſel were well ſtop'd, it might be a good way to bury it in the Ground [w], or plunge it under Water, that is ſhaded, as Wells and Ciſterns generally are: tho the Bodies to be preſerved under Water had better be put up in Veſſels of Glaſs, than Veſſels of Earth.

14. In general, Bodies repoſited under Ground, and in ſubterraneous Vaults, or deep Waters, preſerve their freſhneſs longer than above Ground.

Conſervatories of Snow. 15. 'Tis related that in Conſervatories of Snow, whether natural or artificial, Fruit has been found as freſh and beautiful, after lying there for ſeveral Months, as if it had been newly gather'd [x].

In Meal. 16. The Country People have a way of preſerving bunches of Grapes, by burying them in Meal; which tho it renders them ſomewhat unpleaſant to the Taſte, yet preſerves their moiſture and freſhneſs: and all the firmer Fruits are not only long preſerved in Meal, but alſo in Saw-duſt; or heaps of Corn [y].

In Liquors of the ſame kind with the Body. 17. An Opinion has prevail'd, that Bodies are preſervable, freſh and perfect, in Liquors of their own Species; as Grapes in Wine, Olives in Oil [z], *&c.*

Fruits how preſerved. 18. Pomegranats and Quinces may be well preſerved, by ſteeping them awhile in Salt-water; then taking them out and drying them in the open Air of a ſhady place.

19. Bodies are long preſerved by ſuſpending them in Wine or Oil, much better in Honey or Spirit of Wine; but beſt of all, as ſome ſay, in Quick-ſilver.

20. Fruits are long preſerved freſh and green, by coating them over with Wax, Pitch, Plaiſter of *Paris*, Paſte, *&c.* [a]

21. 'Tis

[u] See above Sect. I. 13, 14. and Sect. III. 3, 4.

[w] See a Method of preſerving Fruits and Flowers for a Year, built upon this Foundation, in the *Philoſophical Tranſactions*, N° 237. p. 44.

[x] See Mr. *Boyle*'s Hiſtory of *Cold*.

[y] See the Author's *Sylva Sylvarum*, under the Article *Preſervation*.

[z] This Opinion ſeems to hold in many Reſpects.

[a] Theſe and many other of the following Particulars are farther conſider'd in the *Sylva Sylvarum*; from whence they may appear taken, for the preſent occaſion, according to the deſign of that Piece.

21. 'Tis manifeſt that Flies, Spiders, Ants, *&c.* caſually included in Amber, or immerſed and covered over with the Gums of Trees, never waſte afterwards; tho they are but ſoft and tender Bodies.

22. Grapes, and other Fruit, are preſerved by hanging pendulous: of which ſituation there is a double Convenience; for firſt they are thus preſerved from bruiſing or compreſſure, to which they wou'd be expoſed by lying upon hard Bodies; and ſecondly, the Air ſurrounds them every way equally.

23. 'Tis obſerved, that both Putrefaction and Deſiccation in Vegetables begin not equally on every ſide; but principally in that part thro' which Bodies draw their Nouriſhment when alive: whence ſome direct us in preſerving of Fruit, to ſeal up the end of the Stalk with Wax, or melted Pitch.

The Conſumption of Fewel.

24. Large Wiecks of Candles or Lamps conſume the Tallow or Oil ſooner than leſs; and the Flame of Cotton ſooner than that of Ruſh, Straw, Twig, *&c.* and all Flame moved and agitated by the Wind, conſumes the Fewel faſter than when undiſturbed; and therefore ſlower in a Lanthorn than in the open Air. 'Tis reported alſo that ſepulchral Lamps will continue burning for a very long time.

25. The nature and preparation of the Fewel contributes as much to the continuance of the Light, as the nature of the Flame. Thus Wax burns longer than Tallow, wet Tallow longer than dry, hard Wax longer than ſoft, *&c.*

The manuring of Ground.

26. If the Mould be yearly ſtir'd about the Roots of Trees, the Trees are of ſhorter duration; but, if once in five or ten Years, of longer: So to gather the Buds, and ſtrip off the Twigs of Trees, prolongs their Life. Again, dunging, laying on of Chalk, *&c.* and much watering, conduces to Fertility; but ſhortens the Life of Vegetables.

And ſo much for the preventing of dryneſs and waſting. The buſineſs of ſoftning Bodies once dried, which is the capital Buſineſs, in this Caſe, affords but a few Experiments; we will therefore join ſuch as belong to Men, and other Animals together.

The Enquiry of mollifying or ſuppling the parts once dried in Vegetables.

27. Willow Twigs become more flexible, by ſteeping them in Water; ſo we dip the ends of Birch Rods in Water to prevent their drying: and Bowls of Wood, cleft thro' dryneſs, being put into Water cloſe again.

28. Very old Trees, that have ſtood long unremoved, apparently grow young again, and acquire new and tender Leaves, upon digging and opening the Earth about their Roots.

In Leather.

29. Leather, become hard and ſtubborn by Age, is ſuppled and ſoftned by rubbing it with Oil before the Fire, and in ſome meaſure barely by the warmth of the Fire. Skins and Bladders, when ſomewhat harden'd, grow ſoft again in warm Water, with the addition of any fat Subſtance; but better ſtill if rubbed a little.

In Oxen.

30. Old Draught-Oxen, worn out with Service, being put into freſh Paſture, get new and tender Fleſh; that eats like young Beef.

In Men. 31. A dry and ſtrict Diet of Guaiacum, Biſket, *&c.* uſed in the Cure of the venereal Diſeaſe, *&c.* brings Men to extreme Leanneſs, and conſumes the Juices of the Body; which afterwards beginning to be recruited, grow manifeſtly more young and freſh: and we judge that emaciating Diſtempers, being well cured, have prolonged the Lives of many.

Larger OBSERVATIONS.

(1.) Men have a ſtrange Talent, and ſee ſharply in the night of their own Notions; but wink, and prove weak-ſighted in the Day-light of Experience: they talk of the elementary Quality of Dryneſs, of Dryers, and the natural Periods of Bodies whereby they are corrupted and conſumed, without obſerving any thing of Uſe, as to the Beginnings, the Means, and the Ends of Dryneſs and Conſumption.

(2.) The Proceſs of Dryneſs and Conſumption conſiſts in three Actions; and theſe Actions have their Origin from the native Spirit of Bodies, as was before obſerved.

(3.) The *firſt* Action is the Attenuation of Moiſture into Spirit; the *ſecond* is the Exit or Eſcape of the Spirit; the *third* is the immediate Contraction of the Parts of the Body after the Spirit is gone: and this laſt is that Deſiccation and Induration we are now principally concerned with; the two former tending only to conſume.

(4.) In the caſe of Attenuation, the thing is manifeſt; for the Spirit included in all tangible Bodies operates without ceaſing, and whatever it lays hold of, can digeſt and work upon, it converts into itſelf, entirely changes, ſubdues, multiplies itſelf thereon, and begets new Spirit. This receives an eminent Confirmation from hence, that Bodies much dried loſe in weight, become hollow, ſpungy, and ſonorous from within; whilſt 'tis certain that the internal Spirit contributes nothing to the weight of the Body: whence it neceſſarily follows, that the internal Spirit muſt have converted into itſelf the Moiſture and Juice of the Body which before had Gravity; whence the Diminution of the Weight. And this is the *firſt Action*; *viz.* the Attenuation of the Moiſture and its Converſion into Spirit [b].

(5.) The ſecond Action; *viz.* the Eſcape or Avolation of the Spirit, is likewiſe manifeſt; for when this happens largely, 'tis apparent even to the Senſe, in Vapours to the Sight, and in Odours to the Smell; but when it happens gradually, as it does thro' Age, 'tis then performed inſenſibly; tho the Caſe, in effect, be the ſame. And where the Texture of the Body is ſo cloſe and tenacious that the Spirit can find no Pores or Paſſages, at which to iſſue; here alſo, in its Endeavour to get out, it drives the groſſer Parts of the Body before it, and thruſts them above the Surface: which is the Caſe in the ruſting of Metals, and the Corruption of all fat Bodies.

(6.) The

[b] What this internal Spirit is, See below *Sect.* XI.

(6.) The third Action is ſomewhat obſcure, but no leſs certain than the others, being a Contraction of the groſſer Parts, after the Spirit is diſcharged. And, *firſt*, we ſee that Bodies manifeſtly ſhrink, and poſſeſs leſs Space, after the Exit of the Spirit; as we find in Nut-kernels, which when dried do not fill the Shell: and again, in Boarding and Paling, where the ſeveral Planks, or pieces of Wood, are laid cloſe together at firſt; but gape and ſhrink from each other when dried. In like manner Bowls, and other Wood-work, crack and ſplit with Dryneſs; whilſt the Parts contract themſelves, and thus of neceſſity leave empty Spaces between. *Secondly*, This appears from the wrinkling of dry Bodies; the endeavour of contracting themſelves being ſo forcible as to bring the Parts together, and raiſe them up; for whatever is contracted in the Extremities muſt riſe up in the middle, as we ſee in Paper, Parchment, the Skins of Animals, and in the Coat of ſoft Cheeſe: all which grow wrinkled with Age. *Thirdly*, This Contraction appears ſtill more remarkably in ſuch things as do not only wrinkle, but twiſt, curl up, and roll themſelves round with Heat; as Parchment, Paper, and Leaves do when expoſed to the Fire: for Contraction, through Age, proceeding but ſlowly, generally produces Wrinkles; whilſt Contraction by the Fire, being ſudden, cauſes curling. But in many Bodies where neither wrinkling nor curling can happen, there enſues a bare Contraction, Shrinking, Hardneſs, and Dryneſs, as we firſt obſerved. But if the Spirit be ſo far exhaled, and the Moiſture ſo far conſumed, as not to leave enough of the Body to unite and contract itſelf, then all Contraction neceſſarily ceaſes; the Body becomes rotten, and no more than a heap of Duſt, clinging together, which is diſſipated by a ſlight Touch, or thrown off into the Air; as we ſee in all Bodies greatly conſumed; *viz.* Paper and Linen, burnt to the utmoſt; and in dead Bodies embalmed after lying many Ages.

(7.) It muſt be obſerved that Fire and Heat only dry by accident; for 'tis their proper Office to attenuate and dilate the Spirit and the Moiſture: but it follows by Accident, that the other Parts contract themſelves, either to prevent a *Vacuum*, as the vulgar Phraſe is; or by the concurrent Action of ſome other Motion, about which we are not now enquiring.

(8.) 'Tis certain that Putrefaction, as well as Arefaction, has its Origin from the native Spirit; tho it proceeds in a very different way: for, in Putrefaction, the Spirit not being ſimply diſcharged, but in part detained, has ſtrange Operations and Effects; whilſt the groſſer Parts alſo ſuffer, not a local Contraction, ſo much as a joint and homogenious Union [c].

SECT.

[c] See the Article *Putrefaction*, in the *Sylva Sylvarum*.

SECT. IV.

The Hiſtory of the LENGTH *and* SHORTNESS *of* LIFE *in* ANIMALS; *purſuant to the third Article of the* Table of Enquiry.

Preparation. *WITH regard to the Length and Shortneſs of Life in Animals, the Information procurable is but ſlender, Obſervation ſlight, and Tradition fabulous. Tame Creatures are corrupted by a degenerate Life; and wild ones intercepted by the inclemency of the Weather. Neither do the things which may ſeem concomitant aſſiſt us much in this Enquiry; as the bulk of the Body, the period of Geſtation, the number of Young, the time of Growth, &c. theſe being complicated Conſiderations, that ſometimes concur and ſometimes not.*

The Age of Man. 1. The Age of Man, ſo far as can be collected from certain Hiſtory, exceeds that of all other Animals, excepting a very few; and the Concomitants in him are found tolerably equable: his Size and Stature large, his period of Geſtation nine Months, his Offspring generally ſingle, his time of Puberty at fourteen, and his Growth reaching to twenty Years.

Of the Elephant. 2. The Elephant certainly exceeds the ordinary Age of Man; their period of Geſtation is not ten but two Years, or at leaſt above one; their Bulk vaſt; their Growth till thirty; their Teeth exceeding ſtrong: their Blood is obſerved to be the coldeſt of all Animals; and they ſometimes live two hundred Years[e].

The Lion. 3. Lions are thought to be long lived, becauſe many of them have been found toothleſs; but this is no certain Sign, as it may proceed from their corrupt Breath, or other Cauſe.

The Bear. 4. The Bear is a great Sleeper, and a ſluggiſh indolent Creature, yet not obſerved to be long lived; they ſhould rather ſeem to be ſhort lived, from their very ſhort period of Geſtation, ſcarce reaching to forty Days.

The Fox. 5. The Fox ſeems well provided for long Life; as being well covered, carnivorous, and living under Ground; yet he is not obſerved to be long lived: doubtleſs he is of the Dog-kind, which is but ſhort lived.

The Camel. 6. The Camel is long lived; a lean ſinewey Creature, that commonly reaches to fifty, and ſometimes to a hundred.

The Horſe. 7. The Horſe ſhares a middle Life, ſcarce attaining to forty, and uſually not to more than twenty; but this ſhortneſs of Life he probably owes to Man: for the Breed of the Sun is now no more, that ranged at large in freſh Paſture; yet the Horſe continues growing till ſix, and generates in old Age. The Mare alſo goes longer with Young than the Woman; and but ſeldom foals double. The Aſs has nearly the ſame Age as the Horſe: But the Mule is longer lived than either.

8. The

[e] See the Account of Elephants in the *Philoſophical Tranſactions*.

8. The Stag is vulgarly famed for long Life; but upon no certain Hiſtory. There goes a Report of a certain Stag found with a Chain about his Neck, buried in Fat. That he ſhould be a long lived Creature ſeems leſs probable, becauſe he comes to his full Growth at five; ſoon after which his Horns, which are yearly ſhed and renewed, grow from a narrower Baſis, and leſs branching. *Deer.*

9. The Dog is a ſhort lived Creature, that laſts not above twenty Years; and ſeldom ſees fourteen: he is hot, and lives unequably; as being often in violent Motion, and often ſleeping. The Bitch has many young ones at a Litter; and goes with them nine Weeks. *The Dog.*

10. The Bull or Ox is very ſhort lived for his Size and Strength, ſcarce exceeding ſixteen Years; tho ſomewhat more laſting than the Cow. She has ſeldom more than one Calf at once; and goes about ſix Months. This is a ſluggiſh and fleſhy Creature, that eaſily grows fat, and feeds wholly upon Herbage. *The Ox.*

11. Sheep ſeldom live to ten, tho a Creature of a moderate Size, and well covered; and tho ſharing but a very ſmall proportion of Gall, yet their Coat is exceedingly curled, beyond that of any other Animal. The Ram generates not till the third Year; and continues fit for Generation to the eighth. The Ewe continues to bear as long as ſhe lives. 'Tis a Creature ſubject to Diſeaſes, and ſeldom lives out its full courſe. *The Sheep.*

12. The Goat approaches the Sheep in Age, and almoſt every thing elſe; tho a more nimble Creature, and of a ſomewhat firmer Fleſh; whence he ſhould ſeem longer lived: but he is much more ſalacious, and therefore ſhorter lived. *The Goat.*

13. The Hog ſometimes lives to fifteen or even twenty; and tho its Fleſh be the moiſteſt of all Animals, yet this ſeems to contribute nothing to the Prolongation of Life. But for the wild Boar, there is no certain account of him. *The Hog.*

14. The Age of the Cat terminates between ſix and ten: a nimble Creature, abounding in Spirit, that eats voraciouſly, and ſwallows without much chewing. *The Cat.*

15. The Hare and Rabbet ſcarce laſt ſeven Years: they are both great Breeders, and have many young at once. They differ in this, that the Rabbet lives under Ground, and the Hare above; and, that the Fleſh of the Hare is the darkeſt. *The Hare.*

16. Birds fall far ſhort of Quadrupedes in bulk of Body: an Eagle, or a Swan, being but little things compared to an Ox, or a Horſe; or an Oſtrich compared to an Elephant. *Birds.*

17. Birds are well covered; for Feathers exceed Wooll and Hair in point of Warmth, and ſitting cloſe to the Body.

18. Tho Birds have many young at once, yet they go not with them together, but lay their Eggs at ſeveral times; whence the Chick receives a more copious Nouriſhment.

19. Birds maſticate but little, if at all; whence their Aliment is often found whole in their Crop; yet they will break the Shell of a Nut, and pick out the Kernel.

20. The

20. The Flight of Birds is a mix'd Motion, compounded of the Motion of the Limbs and that of Carriage; which makes a very wholſome kind of Exerciſe.

21. 'Tis well obſerved by *Ariſtotle*, as to the Production of Birds, that the Male Seed contributes little to their Generation; but ſupplies rather Activity than Matter: whence an Egg productive of a Chick is, in many reſpects, undiſtinguiſhable from one that is not.

22. Moſt Birds come to their full Growth the firſt Year, or ſoon after: their Age is reckoned by the Feathers in ſome, and by the Beak in others; but not by the magnitude of their Bodies.

The Eagle. 23. The Eagle is accounted long lived; tho its Years are not obſerved. And 'tis eſteemed a ſign of his long Life, that he caſts his Beak, and thence grows young again: whence the Proverb *Aquilæ Senectus*. But perhaps 'tis not the Renovation of the Eagle that caſts the Beak, but the Change of the Beak that renews the Eagle; for when the Beak grows too hooked, the Eagle muſt feed with difficulty.

The Vulture. *The Kite.* 24. The Vulture is alſo ſaid to be long lived; ſo as to laſt a hundred Years. The Kite likewiſe, and all carnivorous Birds, and Birds of Prey, live long. But for the Hawk, as ſhe lives a degenerate and ſervile Life under the Faulkoner, no true Eſtimate can be made of the natural Period of her Duration: but the tame Hawk has been ſometimes obſerved to live thirty Years, and the wild one forty.

The Raven. 25. The Raven likewiſe is ſaid to live long, ſometimes to a hundred; a carnivorous Bird, not much upon the Wing; but rather ſedentary, and having very black Fleſh. But the Crow, which reſembles the Raven, except in Size and Voice, is ſomewhat ſhorter lived.

The Swan. 26. The Swan is certainly found to be a very long lived Creature, and often reaches to above a hundred: a Bird excellently plumed, that feeds on Fiſh, and delights in running Waters.

The Gooſe. 27. The Gooſe alſo is a long liver, but particularly the wild one; tho a Creature that feeds on Herbage; whence the *German* Proverb: *older than a wild Gooſe.*

The Stork. 28. Storks muſt needs be long lived, if the ancient Obſervation of them be juſt, that they never came to *Thebes*, becauſe the City was often taken: for, if this were true, they muſt have had the Memory of more than one Age, or elſe the old ones muſt have taught the young ones Hiſtory: but Fables are endleſs.

The Phœnix. 29. And ſo much is Fable interwove with the Hiſtory of the Phœnix, as quite to bury the Truth, if there were any in it; tho there is no great Wonder at what they anciently wonder'd at; *viz.* that this Bird ſhould be alway ſeen flying with a great Attendance of others: for we ſee the ſame thing happen to an Owl flying by day; or to a Parrot that has quitted the Cage.

The Parrot. 30. A Parrot has certainly been known to live ſixty Years in *England*; but how old he was when brought over is uncertain: a Bird that feeds promiſcuouſly,

miſcuouſly, that maſticates his Meat, and caſts the Beak; being likewiſe bold, ſtubborn, and black of Fleſh.

31. A Peacock lives to twenty; but has not his *Argus* Eyes till three Years old: a Bird of ſtately Step, and whitiſh Fleſh. *The Peacock.*

32. The Dung-hill Cock is a ſalacious, martial, ſhort-lived Bird; exceeding briſk, and white of Fleſh. *The Cock.*

33. The Turkey Cock ſomewhat out-lives the Dung-hill Cock: an iraſcible Bird, and of very white Fleſh. *The Turkey.*

34. The Ring-dove is a long liver, and ſometimes laſts till fifty: a Bird of the Air, that ſits and builds high; but Doves and Turtles are ſhort livers, and ſcarce exceed eight Years. *The Ring-dove.*

35. Pheaſants and Partridges may live to ſixteen Years; being great Breeders, but of more duſky Fleſh than the Pullet kind. *The Pheaſant.*

36. The Black-bird is ſaid to be the longeſt lived of all ſmall Birds: a bold Bird, and loud of Voice. *The Black-bird.*

37. The Sparrow is obſerved to be very ſhort lived; which is attributed to Salacity in the Cock: but the Linnet, a Bird no bigger in Body, is obſerved to live twenty Years. *The Sparrow.*

38. Of the Eſtrich we have no certain account; thoſe bred amongſt us have not been found to live long: and as to the Ibis, ſhe is only recorded for a long liver, without mentioning her time. *The Eſtrich.*

39. The Lives of Fiſh are known with more uncertainty than thoſe of Land Animals; as being leſs obſerved on account of their living under Water: moſt of them are without Reſpiration; whence their vital Spirit is more pent in; and therefore, tho they refreſh themſelves by their Gills, yet that kind of cooling is not ſo conſtant as by breathing. *Fiſh.*

40. As they live in Water, they eſcape the dryneſs and depredation cauſed by the external Air; but, no doubt, the ſurrounding Water which enters, and is received into the Pores of their Bodies, proves more prejudicial than Air.

41. Their Blood is ſaid to have very little Heat; ſome of them are very voracious, and prey even upon their own Species: their Fleſh is ſofter, and leſs tenacious than of Land-Animals; but they fatten in an extraordinary manner, ſo that an incredible Quantity of Oil is afforded by the Whale Kind.

42. Dolphins are reported to live about thirty Years; the Experiment having been tried by cutting off the Tails of ſome of them: and they continue growing till ten. *The Dolphin.*

43. They report a ſtrange thing of ſome Fiſh; that after a certain Age their Bodies waſte greatly, while their Heads and Tails remain of the former Size.

44. The *Muræna* was obſerved, in *Cæſar*'s Fiſh-ponds, to live ſixty Years; and by long Uſe this kind of Fiſh was made ſo tame, that *Craſſus* the Orator bewail'd the Loſs of one of them. *The Muræna.*

45. The Pike is found much the longeſt Liver of all freſh-Water Fiſh; ſometimes continuing for forty Years: a voracious Fiſh of prey, whoſe Fleſh is firm and dry. *The Pike.*

The Carp. 46. But the Carp, the Bream, the Tench, the Eel, *&c.* are not thought to live above ten Years.

The Salmon. 47. The Salmon is quick of Growth, but ſhort-lived; ſo is the Trout: but the Pearch grows ſlow, and lives longer.

The Whale. 48. As to the Life of Whales, and the like Fiſh of vaſt bulk, we have no certain account; nor of the Sea-calf, the Sea-hog, and innumerable other Kinds of Fiſh.

The Crocodile. 49. The Crocodile is reported to be very long lived, and alſo to have an extraordinary period of Growth; inſomuch that this is held the only Animal which grows as long as it lives. 'Tis an oviparous Creature, voracious, cruel, and well defended againſt the Water. But for any kind of Shell-fiſh, we find no certain account of their length of life[f].

Larger OBSERVATIONS.

'Tis difficult to diſcover any Rule of the Length and Shortneſs of Life in Animals; as well through a Neglect of Obſervations, as the Complications of Cauſes.

(1.) There are more Birds than Quadrupedes found to be long lived; as the Eagle, the Vulture, the Kite, *&c.* tho they attain their full Growth in one Year, and are leſs of Body. Doubtleſs their Plumage is an excellent Covering againſt the Inclemency of the Seaſons; and as they chiefly live in the free Air, they are like the Inhabitants of clear Mountains, who prove long lived. Their Motion alſo, in their Flight, is leſs fatiguing, leſs ſhaking, and more wholeſome. Nor do the firſt Rudiments of Birds ſuffer any Compreſſion, or want of Aliment in the *Uterus* of the Female. But the principal Reaſon ſeems to be, that Birds are rather formed of the Subſtance of the Female than the Male: whence their Spirit is not ſo hot and fretting.

(2.) It may well be ſuppoſed, that the Animals made more of the Subſtance of the Female than the Male, are longeſt lived; and that ſuch as are longeſt gone with, will participate more of the Subſtance of the Female than the Male, and are therefore longer lived: whence, in conformity with ſome Obſervations of our own, we judge, even among Men, that thoſe Children which reſemble the Mother live the longeſt; and ſo again, the Children of old Men, begotten upon young Wives; provided the Father was ſound, or no way diſtempered.

(3.) The Beginnings of all things lie moſt open both to Injury and Aſſiſtance; ſo that a leſs degree of Compreſſion, and a larger ſupply of Nouriſhment to the *Fœtus* in the *Uterus*, muſt naturally conduce much to the prolongation of Life; and this happens either when the Young is excluded at different times, as in Birds, which are oviparous; or when the Birth is ſingle, as in Animals that have only one Young at once.

(4.) A

[f] If it were eſſential to the preſent Enquiry, it might be poſſible to procure a ſomewhat more exact and particular Account of the ſeveral Creatures above-mentioned; as alſo of ſeveral others omitted.

(4.) A long continuance in the *Uterus* contributes three ways to the prolongation of Life. Firſt, as the *Fœtus* hence receives more of the Subſtance of the Female. Secondly, as it comes forth more ſtrengthned and confirmed. And thirdly, as it later feels the predatory force of the Air. It alſo ſignifies that the Periods of Nature are performed in greater Revolutions. And altho Lambs and Calves, which remain but about ſix Months in the *Uterus*, are ſhort lived; yet this proceeds from other Cauſes.

(5.) Creatures that feed upon ſimple Herbage, are of ſhort duration; but thoſe that feed on Fleſh, or Seeds, and Fruits, as Birds, are of a longer; for, even Deer, derive one half of their Food from above their Heads: and the Gooſe, beſides Graſs, finds ſomething in the Stubble-fields, and the Water.

(6.) We judge, that the covering of the Body greatly conduces to prolong Life; for this wards off, and prevents thoſe unfriendly Aſſaults of the Air which, otherwiſe, ſtrangely undermine and deſtroy the Body: and Birds are thus admirably fenced by their Plumage. But that Sheep, which are alſo well covered, are of ſhort duration, muſt be imputed to the Diſeaſes whereto that Creature is liable; and to their feeding chiefly upon Graſs.

(7.) The Head is, doubtleſs, the principal Seat of the Spirits; and tho this be vulgarly ſaid only of the animal Spirits, yet it holds equally of them all: and no queſtion but the Spirits greatly prey upon, and conſume the Body, ſo that both a greater quantity, or a greater acrimony and ſharpneſs thereof muſt greatly ſhorten Life: whence we judge it a principal Cauſe of Longevity in Birds, that they have ſuch little Heads in proportion to their Bodies; and conjecture, that ſuch Men as have large Skulls are ſhorter lived than others.

(8.) The motion of Carriage we judge to excel all others for the prolonging of Life; now all Water-fowl, as the Swan, *&c.* have this Motion; ſo have all Birds in their Flight, tho every now and then mixed and compounded with a briſk motion of the Limbs: ſo again have Fiſh; tho as to the length of their Life we have no certainty.

(9.) The Creatures perfected ſloweſt are moſt laſting; for this ſhews that Nature finiſhes her Periods by greater Revolutions; which holds not only of Growth, but of other degrees of Maturity: ſo Man firſt puts forth Teeth, afterwards the ſigns of Puberty, then the Beard, *&c.*

(10.) The timorous Animals are not long lived; as the Sheep, the Pigeon, *&c.* for the Bile is the Spur to many Functions in the Body.

(11.) The Creatures whoſe Fleſh is dark-coloured, are longer lived than thoſe whoſe Fleſh is white; as indicating the Juices of the Body to be more compact, and leſs diſſipable.

(12.) In all corruptible Bodies, Quantity has a great tendency to the preſervation of the whole; a great Fire is not ſoon quenched; a ſmall quantity of Water is ſoon evaporated; a Branch withers faſter than the Trunk of a Tree; and therefore, in general, as to Species, tho not to Individuals, the

larger Animals are longer lived than the ſmaller, unleſs ſome other powerful Cauſe intervene [s].

SECT. V.

The Hiſtory of ALIMENTATION, *and the Proceſs of* NUTRITION: *with regard to the Fourth Article of the* Table of Enquiry.

Aliment to be of a lower nature than the Body nouriſhed.

1. ALL Aliment ſhould be of an inferior Nature, and a more ſimple Subſtance than the Body intended to be nouriſhed: Plants are fed by Earth and Water, Animals by Plants, and Men by Animals. There are alſo other carnivorous Creatures; and Man himſelf makes Plants a part of his Food: but Men, and other carnivorous Animals, are difficultly nouriſhed by Plants alone; tho perhaps they might, by long uſe, with Fruits and Seeds that had felt the Fire; but not by Leaves or Herbage; as the Order of the *Folietani* experienced.

Shewn in Vegetables, living Creatures, and Men.

2. But too near an approximation, or ſimilarity of Subſtance betwixt the Aliment and the Body to be nouriſhed ſucceeds ill; for Creatures that feed on Herbage, touch no Fleſh: few carnivorous Animals eat the Fleſh of their own Species; and Canibals themſelves do not ordinarily feed upon human Fleſh, but either fall into this Appetite thro' depraved Cuſtom, or a deſire of revenging themſelves upon their Enemies. A Field is not ſown to advantage with the Grain itſelf yielded; nor a Tree ſucceſsfully engrafted with its own Shoot.

Nutrition requires a Preparation of the Aliment.

3. The better the Aliment is prepared, and brought ſomewhat nearer in likeneſs with the Subſtance to be repaired, the better Vegetables thrive, and Animals fatten: for a Shoot planted in the Earth is not fed ſo well as when grafted on a Stock agreeable to its Nature; where it finds its Nouriſhment ready digeſted and prepared. And it has been lately diſcovered, that the Slips of wild Trees; as of the Elm, the Oak, the Aſh, *&c.* yield a much larger Foliage by Inciſion, than without it. Men alſo are not ſo well nouriſhed with raw Fleſh, as with that prepared by Fire.

How Plants, and Animals, are nouriſhed.

4. Animals receive their Nouriſhment by the Mouth, Vegetables by the Root; and the *Fœtus* in the Mother, by the umbilical Cord: but Birds, for a time, are nouriſhed by the Yolk of the Egg; ſome part whereof is found in their Craw after they are hatch'd.

The motion of the Aliment.

5. All Aliment moves principally from the Centre to the Circumference, or from within, outwards; only Trees and Plants are rather nouriſhed by the Bark, and external Parts, than by the Pith, and internal: for if but a narrow

[s] Theſe Obſervations are a kind of deep phyſical Corollaries, ſagaciouſly drawn from the preceding Facts, or Hiſtory of Nature; and ſhould be underſtood as ſo many firſt Attempts at a juſt *Interpretation of Nature*, with regard to the preſent Subject.

narrow Slip of the Bark be peeled off all round the Trunk, the Tree dies [h]: and the Blood in the Veins of Animals nouriſhes the Fleſh ſituated below as well as above them.

Two Actions in Alimentation.

6. There are two Actions in all Alimentation; *viz.* Extruſion and Attraction; the former whereof proceeds from an internal, and the latter from an external Power [i].

The Difference betwixt the Aſſimilation of Vegetables and Animals.

7. Vegetables aſſimilate their Nutriment ſimply, without Excretion; for Gums and the Tears of Trees are rather Redundancies than Excrements; and Fungus's are Diſeaſes: but the Subſtance of Animals has a greater Perception of its like, and is therefore endowed with a Principle of Rejection; whereby it refuſes the uſeleſs, and aſſimilates the uſeful Parts [k].

Nutriment paſſes thro' a ſlender Neck in Fruits.

8. 'Tis a remarkable thing in the Stalk of Fruit, that all the Nutriment, which ſometimes produces ſuch large Maſſes, ſhould be compelled to paſs thro' ſo ſlender a Neck; for Fruits never adhere to the Trunk or Branches without ſome Stalk between.

The ſeminal Power more laſting in Plants than Animals.

9. 'Tis obſervable that animal Seed is uncapable of Nutrition, unleſs it be freſh; whilſt the Seeds of Vegetables remain nouriſhable for a long time. Shoots however will not grow, unleſs grafted freſh and green; nor will Roots themſelves long preſerve their vegetative Power, unleſs covered over with Earth.

The degrees of Nutrition differ with the Age.

10. The degrees of Nutrition in Animals differ with their Age; the *Fœtus* is firſt nouriſhed by the Juices of the Mother; with Milk, after the Birth; next with Meats and Drinks; and in old Age, the groſſer and higher reliſhed Foods are generally the moſt agreeable.

A Precept for farther Enquiry.

11. It has a capital tendency to the preſent Enquiry, with diligence and attention to diſcover, whether Nutrition may not be performed from without; at leaſt otherwiſe than by the Mouth. Baths of Milk are uſed in Conſumptions, and emaciating Diſeaſes; and ſome Phyſicians judge a degree of Nutrition procurable by Glyſters. Let this be examined to the bottom: for if Nutrition could be ſecured by Externals, or otherwiſe than by the Stomach; then the weakneſs of Digeſtion which attends old age, might be compenſated by ſuch Helps; and a Renovation be thus procured [l].

SECT.

[h] Perhaps this is not confirmed.

[i] As in the Action of the abſorbent Veſſels, and excretory Ducts.

[k] What is properly meant by this perceptive Principle, may appear from the *De Augmentis Scientiar.* Sect. X. p. 112.

[l] This Enquiry ſeems not hitherto ſufficiently proſecuted, to determine with certainty, how far Nutrition is procurable by Glyſters, Unguents, Baths, impregnated Air, *&c.* Something however we find caſually effected in this Way; but the thing requires an expreſs Set of Experiments to meaſure its Force, and reduce it to Rule.

SECT. VI.

The Hiſtory of the Length *and* Shortneſs *of* LIFE *in* MAN; *with reſpect to the fifth, ſixth, ſeventh, eighth, ninth, and eleventh* Articles *of the* Table of Enquiry.

Particular Inſtances of long life in the Antediluvians.

1. THE Scripture relates that, before the Flood, Men lived to ſeveral hundreds of Years; tho none of the Antediluvians arrived to a thouſand. This Longevity cannot be attributed to Grace, or the ſacred Lineage; becauſe there are reckoned, before the *Deluge*, eleven Generations, and but eight Generations of the Sons of *Adam* by *Cain*; ſo that the

Poſtdiluvians.

Poſterity of *Cain* ſeems to have been longeſt lived. This great age however was, immediately after the Flood, reduced to an half; tho only in ſuch as were born poſterior to the Flood: for *Noah*, who was born prior to it, arrived at the age of his Fathers; and *Shem* lived to ſix hundred Years. But three Generations after the Deluge, the Life of Man was reduced to about a fourth of the primitive Standard; that is, to about two hundred Years.

Abraham. Iſaac. Jacob. Iſhmael. Sarah.

2. *Abraham* lived a hundred and ſeventy-five Years; a couragious and proſperous Man. *Iſaac* lived to a hundred and eighty; a Man of Peace and Chaſtity. And *Jacob*, a Man of Troubles and a numerous Offſpring, held out to a hundred and forty; being patient, mild and ſubtile. *Iſhmael*, a military Man, lived a hundred and thirty Years. *Sarah*, the only Woman whoſe age is mentioned, lived to a hundred and twenty-ſeven; a Woman of Beauty and Reſolution; an excellent Mother and Wife; no leſs famous for her Frankneſs than her Duty to her Huſband.

Joſeph. Levi.

Joſeph, a prudent and politick Man, who ſuffered Affliction in his youth, but afterwards ſaw great Felicity, lived to a hundred and ten Years. His elder Brother *Levi*, lived to a hundred and thirty-ſeven; a revengeful Man and impatient of Injuries. The Son of *Levi* alſo arrived at nearly the ſame age; ſo did his Grandſon, the Father of *Moſes* and *Aaron*.

Moſes.

3. *Moſes* lived a hundred and twenty Years; a Man of Courage, tho of great Meekneſs, and ſlow of Speech. Yet *Moſes* himſelf, in his Pſalm, declares the Life of Man to be but ſeventy Years, and the haleſt Conſtitution but eighty; which ſtandard ſeems, in great meaſure, to have been

Aaron.

obſerved to the preſent time. *Aaron*, who was three Years older, died the ſame year as his Brother; a Man of ready Speech, eaſy Behaviour, and

Phineas.

ſomewhat variable. But *Phineas*, Grandſon to *Aaron*, is computed to have lived three hundred Years; if the *Iſraelitiſh* War againſt the Tribe of *Benjamin*, in which Expedition *Phineas* was conſulted, happened in the order of Time

Joſhua.

the Hiſtory relates it: he was a Man exceedingly zealous. *Joſhua*, a military Man, a great Leader, and always ſucceſsful, lived a hundred and ten Years.

Ehud.

Caleb was his Contemporary; and ſeems his Equal in age. *Ehud* the Judge, ſeems at leaſt to have been a hundred; as after the Victory over the

Moabites, the Holy-Land had eighty years reſt under his Government: he was a bold and daring Man; devoting himſelf to the Service of his People.

4. *Job* after being reſtored to his Felicity, lived a hundred and forty years; and had before his Affliction Children at Man's eſtate: he was a political, eloquent, and beneficent Man, and an Example of Patience. *Eli* the Prieſt, lived ninety eight years; a corpulent Man, of an eaſy Temper, and indulgent to his Children. *Eliſha* the Prophet, ſeems to have lived to more than a hundred; as continuing ſixty years after the Aſſumption of *Elias*; yet at the time of that Aſſumption, the Boys mock'd him by the name of old Bald-head: he was a vehement Man, ſevere, of an auſtere Life, and a deſpiſer of Riches. *Eſaiah* the Prophet, ſeems to have been a hundred, for he is found to have propheſied thro' the Courſe of ſeventy years; but the time he began to propheſy, and the time he died are both uncertain: He was a Man of great Eloquence, propheſied of the Goſpel, and was full of the Promiſes of God as to the new Covenant. Job. Eli. Eliſha. Eſaiah.

5. *Tobias* the elder, lived a hundred and fifty eight years, and the younger a hundred and twenty ſeven; both merciful Men, and charitable. In the time of the Captivity, many of the Jews who returned from *Babylon* ſeem'd to have been long lived; as they are ſaid to have remembred and bewailed the difference of the two Temples, at the diſtance of ſeventy years. Many Ages after this, in the time of our Saviour, we find *Simeon*, a Man of ninety, full of Religion, Hope and Expectation. At the ſame time, *Anna* the Propheteſs is found to have lived to above an hundred; as having been married ſeven years, and a Widow for eighty four; whereto muſt be added the years of her Virgin ſtate; and thoſe ſhe lived after her Propheſy of our Saviour: ſhe was a holy Woman, that ſpent her Days in Prayer and Faſting. Tobias. Jews *in the Captivity.* Simeon. Anna.

6. The Accounts we have of the Longevity of Men in Heathen Authors are little to be depended on; both becauſe of the Fables into which Relations of this kind are very apt to run, and the Fallacies of Calculation. The accounts extant afford nothing remarkable of the *Egyptians*, as to the point of long Life; for their Kings who reigned the longeſt, exceeded not fifty or fifty five Years; which is no great matter, as we ſometimes find the ſame in later days. But the Kings of *Arcadia* are fabled to have been exceedingly long lived: indeed the Country was Mountainous, full of Flocks and Herds, and productive of wholeſome Nouriſhment; but as it had *Pan* for its tutelar God, ſo all the Things related of it, ſeem to have been but panical, idle, and fabulous. Egyptian *Kings.* Arcadians.

7. *Numa*, King of the *Romans*, lived to eighty; a peaceable contemplative Man, addicted to Religion. *Marcus Valerius Corvinus* lived to an hundred, there being forty ſix years between his firſt and ſixth Conſulſhip; a Man of great Valour, and Courage, courteous, popular, and always fortunate. Numa.

8. *Solon* the Legiſlator of *Athens*, and one of the ſeven Wiſe-men, lived to above eighty; a Man of Spirit, yet Popular, and a lover of his Country: he was alſo learned, yet no ſtranger to Pleaſure, and a ſoft Life. *Epimenides* Solon.

Epimenides. *nides* of *Crete*, is reported to have lived a hundred and fifty-ſeven years; tho the Relation has ſomewhat of the Prodigy: for he is ſaid to have paſs'd, or

Xenophanes. ſlept away fifty-ſeven of them in a Cave. Half an Age after this, *Xenophanes* the *Colophonian* lived a hundred and two years, or more; for at the Age of twenty-five, he left his native Country, and travell'd abroad ſeventy ſeven years complete; then returned: but how long he lived afterwards is not certain. He was a Man as wandring in Mind as Body, inſomuch that his Name, by reaſon of his wild Opinions, was changed from *Xenophanes* to *Xenomanes*; tho doubtleſs a Man of a vaſt Imagination, and breathing nothing but Infinity.

Anacreon. 9. *Anacreon*, the Poet, lived to above eighty; an amorous, voluptuary

Pindar. Man, and given to Wine. *Pindar* of *Thebes* likewiſe lived to eighty; a ſublime Poet, of a ſingular Genius, and a great Worſhipper of the Gods.

Sophocles. *Sophocles* of *Athens* arrived to the ſame Age; a lofty Tragick Poet, wholly given to Writing, regardleſs of his Family-Affairs.

Artaxerxes. 10. *Artaxerxes*, King of *Perſia*, lived ninety-four years; a Man of little Genius, impatient of weighty Affairs, a lover of Glory, but a greater lover

Ageſilaus. of Eaſe. At the ſame time, *Ageſilaus*, King of *Sparta*, lived eighty-four years a moderate Man, and a Philoſopher among Princes; yet ambitious and a Warrior: tho no leſs effective in Buſineſs than in Battle.

Gorgias. 11. *Gorgias*, of *Sicily*, lived to a hundred and eight; a Rhetorician, a boaſter of his Knowledge, and one who taught for Profit: he was a great Traveller, and a little before his Death declared he had no Accuſation to

Protagoras. bring againſt old Age. *Protagoras*, of *Abdera*, lived ninety years; he likewiſe was a Rhetorician, but profeſs'd not Arts and Sciences ſo much as Civil

Iſocrates. and Political Matters; being a great Traveller as well as *Gorgias*. *Iſocrates* of *Athens*, lived to ninety-eight: he too was a Rhetorician, tho a very modeſt

Democritus. Man, that appeared not in publick, but had his School at Home. *Democritus*, of *Abdera*, lived to a hundred and nine; a great Philoſopher, and of all the *Greeks* the beſt ſkill'd in Phyſicks, or natural Philoſophy; a great Traveller of Countries, but a greater ſtill in the Works of Nature: he was a diligent Experimenter; and purſued Analogy, rather than obſerved

Diogenes. the Laws of Diſputation. *Diogenes*, of *Sinope*, lived ninety years; a Man who uſed great Liberty towards others, and tyrannized over himſelf, chuſing a ſordid Diet, and practiſing Patience.

Zeno. *Zeno*, of *Citium*, lived to ninety-eight; a Man of lofty Thoughts, great Subtilty, and a deſpiſer of Opinions; yet not troubleſome, but rather catched the Mind than bound it,

Plato. in the manner of *Seneca* after him. *Plato*, of *Athens*, lived to eighty-one; a Perſon of Courage, but a lover of Quiet; ſublime of Thought and ſpeculative; a polite well-bred Man, tho rather agreeable and majeſtick than

Theophraſtus. chearful. *Theophraſtus*, of *Ereſus*, lived to eighty-five; a Man of graceful Eloquence, and a grateful variety of Matter, who collected all that was pleaſing out of Philoſophy, without meddling with what was troubleſome or

Carneades. diſagreeable. *Carneades*, of *Cyrene*, a long time after, alſo lived to eighty-five; a Man of a ready Eloquence, who delighted both himſelf and others with

Orbilius. a pleaſant and agreeable variety of Thought. In *Cicero*'s Time, *Orbilius* the

Grammarian lived to near an hundred, having been firſt a Soldier, then a Schoolmaſter; a ſharp and auſtere Man, both with his Tongue and Pen, and no leſs ſevere to his Scholars.

Quintus Fabius Maximus.

12. *Quintus Fabius Maximus*, continued Augur ſixty three years; whence he muſt needs have lived to above eighty; tho in the Augurſhip, Nobility was more regarded than Age. He was a prudent ſlow Man, moderate in all the parts of Life, and courteouſly ſevere.

Maſiniſſa.

Maſiniſſa, King of *Numidia*, lived ninety years, and had a Son after eighty five. He was a bold Man, that relied upon Fortune, and experienced many Viciſſitudes of Affairs in his Youth; but afterwards enjoy'd a continued run of Felicity.

Porcius Cato.

Marcus Porcius Cato, lived to above ninety; a Man of a very hale Conſtitution, both in Body and Mind; he was ſevere in Speech with his Tongue, delighted in Faction, took Pleaſure in Agriculture, and was Phyſician to himſelf and Family.

Terentia.

13. *Terentia*, Wife to *Cicero*, lived to a hundred and three; a Woman that ſtruggled with many Calamities; as firſt, the Baniſhment of her Huſband, next the Difference between them, again with his final Misfortune, and with frequent Fits of the Gout.

Lucela.

Luceia muſt have lived above a hundred years; for ſhe is ſaid to have acted upon the Stage during a complete Century; playing, perhaps, firſt the part of a Child, and at laſt that of a decrepid old Woman.

Galeria Copiola.

Galeria Copiola, who was both a Player and a Dancer, was brought upon the Stage again, ninety nine years after her firſt appearance thereon; not now indeed as an Actreſs, but as a wonder, at the Dedication of the Theatre by *Pompey* the Great; and again alſo at the votive Solemnities for the Life of *Auguſtus*.

Livia.

14. There was another Actreſs inferior to her in Age, but ſuperior in Dignity, who lived almoſt to ninety, *viz.* *Livia Julia Auguſta*, Wife to *Auguſtus Cæſar*, and Mother to *Tiberius*: for if the Life of *Auguſtus* were a Play, as himſelf wou'd have it, and deſired his Friends to clap him as he died; doubtleſs *Livia* was an excellent Actreſs, who cou'd ſo well ſuit a diſſembled Obedience to her Huſband, with her Power and Authority to her Son. She was an affable, matronal, buſy Lady, and tenacious of Power.

Junia.

Junia, Wife to *Caius Caſſius*, and Siſter to *Marcus Brutus*, lived alſo to ninety; for ſhe ſurvived the Battle of *Philippi* ſixty four years; ſhe was a Woman of Courage, happy in Wealth, but afflicted with the Calamity of her Huſband, Relations, and a long Widowhood; tho ſtill honoured and regarded.

The Taxation in Veſpaſian's *Time.*

15. The ſeventy ſixth year of our Saviour, happening in the time of *Veſpaſian*, is a remarkable Year, wherein we find a kind of Chronicle of long Lives; for in this Year there was a Taxation, which is a Thing that affords the moſt authentick and juſt Information, as to the Ages of Men: and in that part of *Italy* which lies betwixt the *Appennines* and the *Po*, there were found a hundred and twenty four Men of a hundred years old and upwards; *viz.* fifty four of a hundred, fifty ſeven of a hundred and ten, two of a hundred and twenty five, four of a hundred and thirty; again, four of a hundred and thirty five, or thirty ſeven, and three of an hundred and forty years old. Beſides theſe, *Parma* in particular afforded five; three whereof were

each a hundred and twenty, and two a hundred and thirty years old; *Bruxella* afforded one of a hundred and twenty five; *Placentia*, one of a hundred and thirty one; *Faventia*, one Woman of a hundred and thirty two; and a Town then call'd *Velleiacium*, ſituate on the Hills about *Placentia*, afforded ten, ſix whereof were aged a hundred and ten, and four a hundred and twenty. Laſtly, *Ariminum* afforded one aged a hundred and fifty, whoſe Name was *Marcus Aponius*.

Admonition. 16. To ſhorten this Hiſtory, we have here produced, and ſhall go on to produce no Example of an Age under eighty. We affix to each Perſon, a very conciſe and juſt Character or Elogy, of the kind that, in our Judgment, has ſome relation to long Life, is not a little regulated by Men's Manners and Fortunes. This relation to Life is of two kinds; and intimates either that ſuch Perſons generally prove long lived; or that ſuch, tho leſs diſpoſed thereto, may yet ſometimes live long.

The Emperor of Germany, *&c.* 17. Among all the *Roman* and *Grecian* Emperors, together with thoſe of *Gaul* and *Germany*, down to our own Age, containing a Liſt of about two hundred Princes, there are found but four who arrived at the Age of eighty. To theſe may be added, the two firſt Emperors, *Auguſtus* and *Tiberius*; the latter whereof lived to ſeventy eight, and the former to ſeventy ſix; tho both of them perhaps might have lived to eighty, but for *Livia* and *Caius*.

Auguſtus. *Auguſtus*, was a Man of a moderate Temper, tho earneſt in the diſpatch of Buſineſs; in other Reſpects, calm and ſerene; temperate in his Diet, but profuſe in Venery, and happy in all Things. In the thirtieth Year of his Age, he ſuffered a ſevere and dangerous Illneſs, inſomuch that his Life was deſpair'd of; but *Antonius Muſa*, his Phyſician, when the reſt had applied hot Remedies for the Diſtemper, cured him by the application of cold ones; which,

Tiberius. perhaps, was of Service in prolonging this Emperor's Life. *Tiberius* was a Man of *ſlow Jaws*, as *Auguſtus* call'd him, being ſlow, tho powerful in Speech: he was cruel, a Drinker, and made Luſt a part of his Regimen; yet took great care of his Health, and was uſed to call that Man

Gordianus. a Fool, who after thirty conſulted a Phyſician. *Gordianus* the elder, lived eighty years, and at laſt died a violent Death, before he was well ſeated in the Empire; a couragious, magnificent, learned Man, and a Poet; and till the time of his Death enjoy'd a conſtant Courſe of Happineſs.

Valerian. The Emperor *Valerian* lived ſeventy ſix years, before he was taken Priſoner by *Sapor* King of *Perſia*; after his Captivity he lived ſeven Years in the midſt of Reproaches, and at length died a violent Death; a Man of an ordinary Capacity, effeminate, but lifted up by popular Breath, and failing in Per-

Anaſtaſius. formance. *Anaſtaſius*, ſirnamed *Dicorus*, lived eighty eight Years; a Man of a peaceable Mind, but abject, ſuperſtitious and timorous. *Anicius Juſti-*

Anicius Juſtinianus. *nianus*, lived eighty three years; a Man deſirous of Glory, yet indolent in his own Perſon, but happy and eminent in the Conduct of his Leaders; he

Helena Britanna. was uxorious, not his own Maſter, but led about by others. *Helena Britanna*, the Mother of *Conſtantine* the Great, lived to eighty; a Woman that intermeddled little in civil Affairs, neither in the Reign of her Huſband or Son, but given wholly to Religion; yet of a great Mind, and always happy.

Theodora

Theodora the Empreſs lived to above eighty; a Woman of Buſineſs, that delighted in governing: ſhe was exceeding fortunate, and thence credulous. Theodora.

18. To proceed from ſecular Princes, to the Heads of the Church. St. John. St. *John* the Apoſtle, and beloved Diſciple, lived ninety three years, and is thence juſtly denoted by the Emblem of the Eagle, (breathing nothing but what is Divine, and appearing like a Seraph) among the Apoſtles, by reaſon of his fervent Charity. St. *Luke* the Evangeliſt lived eighty four years, an eloquent Man, and a Traveller; the inſeparable Companion of St. *Paul*, and a Phyſician. St. Luke. *Simeon* the Son of *Cleophas*, call'd the Brother of our Lord, and Biſhop of *Jeruſalem*, lived an hundred and twenty years; and then too cut ſhort by Martyrdom; he was a couragious and conſtant Man, full of good Works. Simeon. *Polycarp* a Diſciple of the Apoſtles, and Biſhop of *Smyrna*, ſeems to have lived above a hundred years, tho taken off by Martyrdom; a Man of a great Soul, heroic Patience, and indefatigable Diligence. Polycarp. *Dionyſius* the *Areopagite*, who was Contemporary with St. *Paul*, ſeems to have lived ninety years; he was call'd the Bird of Heaven, from the high flight of his Theology; and was as remarkable for Works as for Contemplation. Dionyſius. *Aquila* and *Priſcilla*, firſt the Entertainers, and afterwards the Aſſiſtants of St. *Paul*, lived together in happy and memorable Wedlock, to the Age of at leaſt a hundred; for they were ſurviving under *Xyſtus* the Firſt; a noble Pair, and of diffuſive Charity. Aquila *and* Priſcilla. St. *Paul* the Hermite, died at a hundred and thirteen: he lived in a Cave upon ſuch ſimple and coarſe Diet, as ſhou'd ſeem ſcarce able to ſupport Life; he ſpent his whole time in Contemplation and Soliloquy; tho he was not illiterate but learned. St. Paul *the Hermite.* St. *Anthony* the firſt Founder, or, as ſome ſay, the Reſtorer of the Order of Monks, lived to a hundred and five; a devout contemplative Man, yet verſed in civil Affairs: his kind of Life was auſtere and hard, tho he lived in no inglorious Solitude, nor without ſome ſway; having his Monks under him, and receiving the Viſits and Homage of Chriſtians and Philoſophers. St. Antony. St. *Athanaſius* lived to above eighty; a Man of invincible Conſtancy, and always triumphant over Fame; never yielding to Fortune: he was generous to thoſe in Power, he kept in the good Graces of the People, and was a great Maſter in Party diſputes, wherein he engaged with uncommon Heat and Vigour. St. Athanaſius. St. *Jerom*, according to the more general Opinion, lived to above ninety; a fine Writer, and of manly Eloquence; ſkill'd in the Sciences as well as Languages: he was alſo a Traveller, and lived auſtere in his old Age, bearing a great Spirit in private Life, and ſhining diffuſively from Obſcurity. St. Jerom.

19. Two hundred and forty one Popes of *Rome* have now ſucceded to the Chair; of which Number only five are found to have lived up to eighty years; but Martyrdom ſhorten'd the natural Lives of many of the primitive Biſhops. *John* the twenty third Pope lived ninety years; a Man of a reſtleſs Spirit, ſtudious of Novelties, and making many Innovations, ſome for the better, and many for Alteration's ſake; amaſſing together great Wealth and Riches. *Gregory*, call'd the Twelfth, created Pope in Schiſm, and a kind of *Inter-regnum*, lived to ninety; but the Shortneſs of *The Popes of* Rome.

his Papacy leaves us no more of his Character. *Paul* the Third, lived eighty one years; a Man of a calm Mind and deep Knowledge: he was alſo learned, an Aſtrologer, and had a great Regard to his Health; but was, like old *Eli*, over indulgent to his Family. *Paul* the Fourth, lived eighty three years; a Man of a rough and auſtere Temper, of a high imperious Spirit, paſſionate, but eloquent, and ready of Speech. *Gregory* the Thirteenth alſo lived to eighty three; a truly good Man, ſound both in Mind and Body, political, temperate, full of good Works and Charity.

Miſcellaneous Inſtances of Long-Life.

20. The *Eſſenes* among the *Jews* are commonly ſaid to have lived above a hundred years; a Sect that uſed a very ſimple Diet, according to the *Pythagorean* Rule. *Appollonius Tyanæus* lived more than a hundred years; a Man for ſuch an Age, of a graceful Aſpect: he was doubtleſs a wonderful Perſon, and held by the Heathens for divine, but for a Magician by the Chriſtians; he was a *Pythagorean* in his Diet, a great Traveller, lived in Reputation, and was worſhip'd as a Deity; but towards the cloſe of his Life, he was accuſed and reviled, tho he ſtill eſcaped ſafe to the laſt. His Grandfather alſo lived to a hundred and thirty. *Quintus Metellus* lived to above a hundred; and after having happily gone thro' ſeveral Conſulſhips, he was in his old Age made *Pontifex Maximus*, and officiated accordingly for two and twenty Years, without any faultering of the Voice, or trembling of the Hand. *Appius Cæcus* lived to a very great Age, tho his Years are not recorded; the greater part whereof he paſs'd in Blindneſs, tho without being diſpirited; but ſtill manfully governing a numerous Family, a great Dependance, and the Commonwealth itſelf. In the Extremity of his Age he was brought to the Senate in a Litter, and was ſtrenuouſly againſt the making Peace with *Pyrrhus*; and upon that occaſion delivered his Speech, the beginning whereof is exceedingly remarkable, and ſhows an invincible Spirit and Strength. *Hiero*, King of *Sicily*, in the time of the ſecond *Punick* War, lived almoſt to a hundred; a Man moderate both in his Manners and Government, a Worſhipper of the Gods, a religious Preſerver of Friendſhip, beneficent, and always fortunate. *Hippocrates*, the famous Phyſician of *Cous*, lived to a hundred and four, and thereby approved and recommended his Art; a Man of Prudence and Learning, attached to Experience and Obſervation; not endeavouring at Words or Methods, but barely ſeparating and laying down the Sinews of Science. *Aſinius Pollio*, Friend of *Auguſtus*, lived a hundred Years; a Man of great Luxury, but eloquent, and a Lover of Letters; yet vehement, haughty, cruel, and ſeeming born wholly for himſelf. There goes a current Report of *Seneca*, that he lived to a hundred and fourteen, but this cannot be true; for ſo far from being a decrepid old Man when promoted Governour to *Nero*, that he was then extremely fit for Buſineſs; and but a little before that, in the Reign of *Claudius*, was baniſh'd for Adultery with certain Ladies of the firſt Rank; a Crime not ſuitable to ſuch an Age. Many of the *Venetians* are found to be long lived, even among their Nobles; as the Duke *Franciſcus Donatus Thomas Conterenus*, and *Franciſcus Molinus*, both of them Procurators of St. *Mark:* but the moſt remarkable Inſtance is, that of *Cornaro* the *Venetian*, who being a Valetudinarian, at firſt began

to

to eat and drink by Weight and Measure, for the sake of his Health, which brought him by degrees to a certain Diet; and this Diet to a very long Life, even that of a hundred Years and more, with the entire use of his Senses, and a constant course of Health. And in our Time, one *Postel* a *French* Man, lived almost to a hundred and twenty; the extremity of his Beard, on the Upper-lip, growing dark, not at all grey: the Man was disordered in his Senses, a great Traveller, a Mathematician, and somewhat heretical.

20. Amongst us, in *England*, perhaps there is no populous Village wherein a Man or Woman of eighty may not be found. A few Years since, at a Wake in *Herefordshire*, there was a Dance performed by eight Men, whose Ages put together made up eight hundred Years; for so much as some of them fell short of a hundred, others exceeded [z].

21. In *Bethlem-hospital*, in *London*, destin'd to the Reception of Lunaticks, there are found, from time to time, many distracted Persons long lived. And so much for the *History of Longevity* in Man, with regard to Individuals. We next proceed to *collective* or *general Observations*.

General Observations with regard to Longevity.

22. The Succession of Ages, and of the Generations of Men, seems no way to shorten the length of human Life; since the Age of Man down from *Moses*'s time to the present, has stood at about eighty years, without gradually declining, as one might have expected. But, doubtless, there are Times in every Country, when Men live to a longer or a shorter Term; and they generally prove longest-lived, when the Times afford but a simple Diet, and give greater occasion to bodily Exercise; and shortest-lived, when the Times are more polite, or abound in Luxury and Ease: but these Things have their Changes and Revolutions; whilst the Succession of Mankind holds on, uninterrupted, in its Course. And, no question, but the Case is the same in other Animals; as neither Oxen, Horses, Sheep, *&c.* have had their term of Life shorten'd in the latter Ages; and therefore the Lives of Creatures, it should seem, were at once abridged by the Deluge. And the like may happen from other grand Accidents; as particular Inundations, long continued Droughts, Earthquakes, *&c.* This Observation seems likewise to hold with regard to the Size or Stature of the Body, which alters not with the Succession of Generations; tho *Virgil*, following the common Opinion, predicted Posterity should diminish in their Size [a]. For tho, 'tis certain, there have antiently been Men of a gigantic Stature; as appears from their Remains found in *Sicily* and elsewhere, in antique Sepulchres, Monuments, and Caverns; yet there has no such thing been continued in the same Places for these three thousand Years, of which we have any authentick Account [b]: tho this Matter likewise is subject to Revolutions and Changes, thro' the Manners

[z] This History might be continued a Century lower, with an Account of many memorable Persons of both Sexes, who have lived to above fourscore, and some to above an hundred; particularly such as old *Parr*, *Jenkins*, &c.

[a] *Grandiaque effossis mirabitur ossa sepulchris.*

[b] And possibly the Bones here mention'd might be the Bones of Elephants, not of Men.

Manners and civil Cuſtoms of Men, no leſs than the former. The more regard ſhould be had to theſe Obſervations, becauſe Men are is poſſeſs'd with a Notion, that the Age of the World is conſtantly upon the Decline, both as to the length of Life, and the ſize and ſtrength of the Body; and that all things decay and tend to the worſe.

The Inhabitants of the Northern Regions longer lived than the Southern.

23. In the cold Northern Countries Men generally live longer than in hot ones; which happens from hence, that the Skin of the Body is there more conſtringed, the Juices of the Body leſs diſſipated, the Spirits themſelves leſs ſharp and predatory, or more eaſy to repair; and the Air, as being but little heated by the Sun, leſs conſuming. Under the Equinoctial however, where they have a double Winter and a double Summer, and a greater Equality in the Spaces of Day and Night, they live to a conſiderable Age, if nothing elſe prevent it; as in *Peru*, *Ceylon*, &c.

24. The Inhabitants of Iſlands are generally longer lived than the Inhabitants of Continents; for the People of *Ruſſia* live not ſo long as thoſe of the *Orcades*; nor thoſe of *Africa* under the ſame Parallel, as thoſe of the *Canaries*: the *Japoneſe* alſo, are longer lived than the *Chineſe*, tho the latter are extravagantly fond of long Life. The Cauſe ſeems to be this, that the Sea-Breezes warm in cold Climates, and cool in the hot.

High Situations conducive to long Life.

25. Lofty Situations are more conducive to long Life than low ones; eſpecially if not upon the tops of Mountains, but upon high Lands as to the Situation in general; ſuch as *Arcadia* in *Greece*, and part of *Ætolia*; where the Inhabitants were very long lived. And the caſe would be the ſame in Mountains themſelves, on account of their pure and clear Air, if not accidentally affected by the Vapours riſing from the Vallies, and hanging about all Mountains. Whence the Inhabitants of ſnowy Mountains are not very long lived; as in the *Alps*, the *Pyreneans*, and the *Apennines*; but all middle ſized Hills, and in Vallies alſo, Men are found to live longer. Again, on the tops of the Mountains running towards *Æthiopia* and the *Abyſſines*, Men lived to a very great Age, and, at this day, often to a hundred and fifty; for here, by reaſon of the Sands at the bottom, little or no Vapour can riſe up to the top of the Mountains.

Low Lands ill ſuited to Strangers.

26. Marſhy, and fenny Lands, eſpecially thoſe lying upon a flat, ſuit better with the Natives than with Strangers, as to the prolonging, or ſhortning of Life: and what ſeems ſtrange, the ſalt Marſhes, which are, at certain ſeaſons, overflowed with Sea-water, prove more unwholeſome than the freſh.

The long lived Countries.

27. The particular Countries remarkable for long lived Inhabitants, are *Arcadia*; *Ætolia*; *India*, on this ſide the *Ganges*; *Brazil*; *Ceylon*; *Britain*; *Ireland*; the *Orcades*, and our *Weſtern Iſlands*.

Wholeſome Air how known.

28. The *Wholeſomneſs of the Air*, eſpecially in a perfect degree, is a ſecret, and conceal'd thing; diſcoverable rather by Experiment than by Reaſoning, and Conjecture. Trial hereof may be made, by expoſing a Fleece of Wooll to the Air, for ſome Days; to ſee if it loſes little of its Weight. Again; by obſerving if a piece of Fleſh will continue long in the Air uncorrupted: And again; if the Weather-glaſs plays within a ſmall compaſs.

paſs. But of theſe, and the like Experiments, let farther Enquiry be made [4].

The Equality of Air regards long Life.

29. Not only the Goodneſs, or Purity, but alſo the Equality of the Air, has regard to long Life. The intermixture of Hills and Vallies, tho pleaſing to the Sight and the Senſe, may be held Suſpect as to lengthning of Life; but a moderately dry Plain, neither too barren, nor totally without Trees and Shade, is better ſuited to procure Longevity.

Inequality and Change of Air, where proper.

30. Inequality of Air is prejudicial in a Manſion-place; but the Change of Air in travelling, after being accuſtom'd to it, is ſerviceable: whence many great Travellers have proved long lived. So likewiſe, ſuch as dwell continually in the ſame little Cottage, without change of Place, are long lived; for that Air conſumes leſs to which the Body is accuſtomed; but change of Air nouriſhes and repairs more.

The Age of the Parents has an Influence on the Children.

31. Tho the Revolution and Number of Succeſſions conduce nothing to the length, or ſhortneſs of Life, as we obſerved above; yet the immediate State of the Parent, both on the ſide of Father and Mother, muſt, doubtleſs, greatly regard it. Thus ſome beget Children when they are old, others when young; ſome at a proper age; ſome when unſound, and ill-diſpoſed; ſome when morbid and languid; ſome when full, and in Liquor; ſome after Sleep, and in the Morning; ſome after a long intermiſſion, or frequent repetition of the conjugal Act; ſome in the heat of a Love-fit, which is commonly the caſe of a ſpurious Iſſue; and ſome again, when the edge of Love is taken off, as after long Cohabitation. And the like Particulars hold alſo of the Mother; whereto may be added her State whilſt ſhe goes with Child, her Health and Diet, together with the Time, or Month, ſhe goes to. 'Tis a difficult thing to reduce all this to Rule, with regard to Longevity; the more ſo, becauſe what a Man might judge for the beſt, may happen to prove the worſt: ſo that alacrity in Generation, which produces Children of a robuſt and active Body, may contribute leſs to lengthen Life, from the Acrimony and Inflammation of the Spirits attending it.

The Particulars in Parents conducive to the long Life of Children.

32. We before obſerved, that a large Participation of the Mother's Juices contributes to the Longevity of the Child: in other Reſpects we judge moderate things the beſt; conjugal Affection, better than looſe; the Morning better for Generation; the ſtate of the Body, not over full, or vigorous, *&c.* It muſt alſo be well obſerved, that the robuſt habit of the Parents, makes better for themſelves than for the Child, eſpecially in the Mother. *Plato* therefore judged, unſkilfully, that the power of Generation was defective, becauſe the Woman did not uſe the ſame exerciſe of Mind and Body as the Man: for a difference of Powers, between the Male and Female, is of greateſt ſervice to the Child; whence Women, and Nurſes, of a delicate and tender Conſtitution, ſupply the beſt and moſt plentiful Nouriſhment to the *Fœtus*, and the Child. Nor were the Children of the *Spartan* Women, who married not before the age of Twenty-two, or, as others ſay, Twenty-five, finer, or longer lived, than thoſe of the *Roman*, *Athenian*, or *Theban* Women,

[4] See the Author's *Sylva Sylvarum*, under the Articles, AIR, PLAGUE, *&c.*

Women, who were marriageable at Twelve or Fourteen. And if the *Spartans* had any great Advantage, it was more owing to their ſparing Diet, than to the late Marriage of their Women. Laſtly, 'Tis manifeſt from Experience, that certain Races of Men are long lived for a Seaſon; inſomuch that Longevity, as well as Diſtempers, may be hereditary and periodical.

Prognoſticks of long Life, from the Complexion.

33. Perſons pale in the Face, Skin, and Hair, are not long lived; but ſuch as are brown, red, or freckly, prove more laſting. Too freſh a Colour in Youth, is not ſo good a ſign of long Life as Paleneſs. A hard Skin denotes a longer Life than a ſoft Skin: but this is not meant of a thick, or Gooſe-ſkin, which ſeems ſpongy; but of one that is both hard and cloſe. So likewiſe a Forehead with large Wrinkles, is a better Sign than one that is ſmooth.

From the Hair.

34. Hard briſtly Hair denotes a longer Life than ſuch as is ſoft and weak; ſo likewiſe does curled Hair, eſpecially if harſh, promiſe better than ſuch as is ſoft and gloſſy: ſo again, does Hair, thick and ſhort-curled, better than that in larger Rings.

From Baldneſs.

35. *Baldneſs*, coming early or late, is a thing indifferent; for numerous bald Men have proved long lived: and even Greyneſs, happening early, is fallacious; for many that were ſoon grey, have lived long after it; nay, to grow grey before the time, without growing bald, is a ſign of long Life, tho not, if attended with Baldneſs.

Hairineſs on the Body.

36. *Hairineſs* on the upper-part of the Body, is a ſign of ſhort life; and thoſe extraordinary hairy on the Breaſt, are not long lived: but Hairineſs on the lower-parts, as the Thighs and Legs, denotes Longevity.

The Size of the Body.

37. Tallneſs of Stature, if not exceſſive, and the Body be well ſet, but not thin, eſpecially if attended with Agility, is a ſign of long Life: as, on the other hand, Men of a ſhort Stature, and ſlow of Motion, live not ſo long.

The Proportion of its Parts.

38. As to Proportion: They who are ſhort in the Body, but long in the Legs, live longer than thoſe who are tall in the Body, but ſhort in the Legs. And again; thoſe who are of a large Make below, but ſlender upwards, the Body thus riſing as it were conical, are longer lived than thoſe who are broad ſhoulder'd, and ſqueez'd in below.

The Habit of the Body.

39. *Leanneſs*, where the Paſſions are calm, and the Temper eaſy; and a full Habit, where the Paſſions prove more vehement; are ſigns of long Life: but Corpulency in Youth, denotes ſhortneſs of Life; tho in Old Age it is a thing more indifferent.

Growth.

40. For Growth to continue long and gradual, is a ſign of Longevity; and if it produce a large Stature, the Sign is great; but ſmaller, if a leſs: as, on the contrary, ſudden Growth to a large Stature, is a bad Sign; but if to a ſhort one, leſs bad.

Fleſhineſs.

41. *Firmneſs of Fleſh*, plump Muſcles and Sinews, a ſmallneſs of Buttock, and a riſing of the Veins, denote long Life; and the contrary, a ſhort one.

The Make of the Head.

42. A ſmall Head in proportion to the Body, a moderate Neck neither long nor ſcraggy, full, nor ſhort, nor as it were buried in the Shoulders; wide

wide Noſtrils, whatever be the form of the Noſe; a large Mouth; an Ear griſtly, not fleſhy; Teeth ſtrong, cloſe join'd, not ſmall, or thin ſet; all theſe are ſigns of long Life; and ſo much the more if any new Teeth ſhoot out in advanced Age.

43. A wide Cheſt, rather ſunk in than prominent; round Shoulders; a flat Belly; a large Hand with but few Lines in the Palm; a ſhort round Foot; a Thigh not over fleſhy; and a firm Calf; are ſigns of long Life. *Cheſt.*

44. A large Eye, with the *Iris* greeniſh; the Senſes not over quick; a Pulſe ſlow in Youth, but quicker as Age comes on; an ability of holding the Breath long; Coſtiveneſs in Youth; and Laxativeneſs in Age; are alſo ſigns of long Life. *Eyes.*

45. There has been nothing remarkable obſerved of the times of Nativity with regard to long Life, except what is aſtrological; which is a Conſideration we here meddle not with: tho it finds a place in our *Tables of Enquiry*. A Birth at eight Months end is ſo far from being long lived, that 'tis ſcarce thought capable of rearing. And Children born in the Winter, are accounted longeſt lived. *Times of Nativity.*

46. A *Pythagorean* or *Monaſtic* Diet and Life, led conformable to ſtrict Rules, and always exactly equable, like that of *Cornaro*, ſeems a thing of great power in the prolongation of Life. On the contrary, of ſuch as live freely, and in the common way, thoſe are frequently found to live the longeſt that eat and drink to the full, or uſe a liberal Table. A moderate or temperate Diet is recommended, and indeed contributes to Health, but has little efficacy in prolonging Life; for the ſtrict Regimen ſupplys few Spirits, and thoſe ſluggiſh; whence it conſumes the leſs; whilſt the full Diet affords a more copious Nouriſhment, and therefore recruits the more: but the moderate one does neither. Indeed where Extremes are hurtful middle Courſes prove the beſt; but where Extremes are ſerviceable, Moderation is of little ſignificance. The ſtrict Regimen requires watching, otherwiſe the few Spirits may be oppreſs'd by much Sleep; it requires little Exerciſe to prevent their waſting; and an abſtinence from Venery, leſt they ſhould be exhauſted: but the full Diet ſuits beſt with full Sleep, frequent Exerciſe, and a ſeaſonable uſe of Venery. Bathing and Anointing conduce more to pleaſure than the prolongation of Life. But we ſhall ſpeak more cloſely to all theſe Heads, when we come to enquire of *Intentions* [e] with a view to Practice. In the mean time, the Advice of *Celſus*, who was not only a Phyſician but alſo a learned and wiſe Man, ſhould not be ſlighted, when he directs a Variety and Change of Regimen; tho ſtill with the advantage to the more grateful ſide: for example, that a Man ſhould ſometimes accuſtom himſelf to watching, and ſometimes indulge himſelf in Sleep, but oftener the latter: That he ſhould ſometimes faſt, and ſometimes eat freely, but oftener the latter: And, that ſometimes he ſhould ſtrongly employ, and ſometimes ſlacken the Faculties of his Mind; but oftener ſlacken them. Doubtleſs, a well regulated Diet has a principal Share in the prolongation of Life; nor have I *Diet.*

[e] See hereafter, *Sect.* VIII.

ever yet met with a Man of any great Age, who did not, when he was aſked, ſay he obſerved a certain Peculiarity in his Diet; ſome one thing, others another. And I remember an old Man of above a hundred, produced as a Witneſs upon an antient Preſcription, who, when he had given in his Evidence, being familiarly aſked by the Judge, what Courſe he took to live ſo long? unexpectedly replied, with the Laugh of the Audience, by eating before he was hungry; and drinking before he was dry.

Courſe of Life. 47. A Life ſpent in religious Duties and Offices, ſeems conducive to Longevity. This kind of Life is attended with Eaſe, Admiration, the Contemplation of divine Matters; noble Hopes, wholeſome Fears, pleaſing Melancholy; continual Renewals by Obſervances, Penances and Expiations, without ſenſual Delights; all which Conditions have a ſtrong tendency to prolong Life. And if to theſe be added, the auſtere Diet, which indurates the Body, and humbles the Spirit; no wonder if it procures a remarkable Longevity: like that of *Paul* the Hermite; *Simeon* the *Stylite*, or *Columnar* Anchorite; with many other Anchorites and Hermites of the Deſart.

Study. 48. What approaches neareſt to the former, is a *Life of Letters*; as that of Philoſophers, Rhetoricians, Grammarians, *&c.* for this alſo turns upon Leiſure, and ſuch Thoughts, as, little regarding the Affairs of Life, have no Severity; but delight by their Variety and Impertinence. Men of Letters alſo live to their own Wiſh, and beſtow their time upon Subjects that pleaſe them beſt; and are commonly in the company of Youth, which is more agreeable. But there is a great Difference betwixt Philoſophies, as to prolonging Life, in reſpect of their Sects; thoſe being the beſt for this purpoſe which have ſomewhat of Superſtition, and ſublime Speculation; as the *Pythagorean*, and *Platonic*. So likewiſe thoſe which ranged the Univerſe, and took in all the Varieties of Nature, and had clear, noble, and lofty Thoughts (as of Infinity, the Stars, heroic Virtues, *&c.*) were conducive to long Life; as the Philoſophies of *Democritus*, *Philolaus*, *Xenophanes*, the Aſtrologers and the *Stoicks*. Thoſe likewiſe were proper to this End, that without any deep Speculation, or ſevere Enquiry, but on the footing of common Senſe, and vulgar Opinions, calmly diſputed on both ſides of the Queſtion; as thoſe of *Carneades*, the *Academicks*, the antient Rhetoricians, and Grammarians. On the contrary, the dogmatical Philoſophies, that turned upon perplexing Subtilities, and examined and wreſted every thing in conformity to certain Principles; and laſtly, all the thorny and ſtrait-laced Philoſophies ſuch as were generally thoſe of the *Peripateticks* and the Schools, are bad for this purpoſe.

A Country Life. 49. A *Country Life* is alſo well ſuited to procure Longevity; as being led much without doors in the open Air, not indolently but in action, and generally ſupported with freſh and unexpenſive Diet, without Envy, without Care.

A Military Life. 50. We likewiſe entertain a good Opinion of a military Life in Youth. Many great Leaders have been long lived; as *Corvinus*, *Camillus*, *Xenophon*, *Ageſilaus*, and others, both Antients and Moderns. 'Tis doubtleſs of ſervice to long Life when all things, from Youth to Old Age, have a favourable and

and friendly Tendency; ſo that a Youth inured to Hardſhips may alleviate and ſweeten Old Age. We likewiſe judge that military Paſſions, on the watch for Battle and Victory, give ſuch a warmth to the Spirits as conduces to Longevity [f].

SECT. VII.

Of REMEDIES *conducing to* Long LIFE: *with regard to the tenth* Article *of the* Table of Enquiry.

Tranſition. THE *Art of Medicine* at preſent in uſe, regards little more than the Preſervation of Health, and the Cure of Diſeaſes; without, or but tranſiently, taking notice of ſuch things as properly contribute to the prolongation of Life. We ſhall however, here lay down the Medicines in eſteem for this purpoſe; which go by the Name of *Cardiacs:* for ſuch Remedies as in Cures defend and corroborate the Heart, or, more properly, the Spirits, againſt Poiſons and Diſeaſes; being judiciouſly, and with choice, introduced into Diet, may very probably alſo conduce, in ſome meaſure, to prolong Life. And this we ſhall do, not in the common way by throwing ſuch Medicines in a promiſcuous Heap; but by ſelecting out the moſt eminent.

A Table of Cordials. 1. *Gold* is exhibited in three Forms; *viz.* that of *Aurum Potabile*, as 'tis called; quenched in Wine; and in Subſtance, as in Leaf or Filings. The *Gold.* *Aurum Potabile* began to be given in dangerous or inveterate Diſeaſes, as an excellent Cordial; and with no deſpicable Succeſs: but we judge, that the Virtue is owing to the Spirit of Salt, which makes the Solution, rather than to the Gold itſelf; tho this be ſtudiouſly concealed. But if the Body of Gold could be opened without a corroſive Menſtruum, or by corroſive Menſtruums without any pernicious Quality; provided the Solution were afterwards well waſhed, we judge it might be an uſeful thing.

Pearls. 2. *Pearls* are taken either in levigated Powder, or in a Magiſtery or Solution, made with the Juice of freſh and very tart Lemmons: they are likewiſe ſometimes given in aromatic Confections; and ſometimes in a fluid Form. Doubtleſs the Pearl has ſome affinity with the Shell it adheres to; and may have a like virtue with the Shells of Crawfiſh.

Gems. 3. Among the tranſparent Gems there are principally two accounted cordial; the *Emerald* and the *Jacynth:* which are given in the ſame Forms as Pearls; excepting that their Solutions are not in uſe, as we know of.

[f] The Deſign appears to be, that the preceding *Hiſtory*, or Number of ſelect Facts, and Inſtances, from *Page* 358 to 365, when duly proſecuted and conſidered, ſhould afford a Set of general *Obſervations* of prime Uſe in this Enquiry; and ſhew the Courſes of Life that have the leaſt and greateſt Tendency to procure Longevity.

But we a little ſuſpect theſe cryſtalline Gems of Roughneſs; or of wounding the Parts like Glaſs.

Bezoar. 4. The *Bezoar Stone* is famed for refreſhing the Spirits, and cauſing a gentle Sweat: but the Horn of the Monoceros has loſt its Reputation; tho it ſtill continues upon the ſame footing with Hartſhorn, the Bone of the Stag's Heart, Ivory, *&c.*

Ambergreaſe. 5. *Ambergreaſe* is one of the beſt things for appeaſing and comforting the Spirits.

Warm Medicines. 6. For warming and invigorating, are recommended Saffron, Indian-leaf, *Lignum Aloes*, Citron-peel, Balm, Baſil, Avens, Orange-flowers, Roſemary, Mint, Betony, and *Carduus Benedictus*.

Coolers. 7. For Coolers are recommended Nitre, Roſes, Violets, Strawberries, both Leaves and Fruit; the Juices of ſweet Lemons, Oranges, and Apples; Borage, Bugloſs, Burnet, Saunders, and Camphire.

Admonition. As we here mention ſuch Medicines only as may be introduced into Diet, we omit all inflammable diſtilled Waters and chemical Oils; and all aromatic, acrimonious, and pungent Remedies; only recommending it to Mens Conſideration, how Waters and Liquors may be prepared from the preceding Ingredients; not in the way of the common phlegmy Waters, by the Still; nor, again, with ardent Spirits; but of a more temperate Naure, yet lively, and breathing a friendly Vapour.

Bleeding ſuſpected, as to Longevity. 8. We are in ſome Doubt as to the frequent Uſe of *Phlebotomy*, whether it conduces to long Life, or not; but rather incline to think it may, when grown into a Habit; and other things are ſuited thereto; becauſe it diſcharges the old Juices of the Body, and gives occaſion to new.

The Cure of emaciating Diſeaſes may contribute to long Life. 9. We likewiſe judge, that a thorough Cure of certain emaciating Diſeaſes conduces to Longevity, as ſupplying new Juices in the room of thoſe conſumed; and becauſe, to recover from Sickneſs is in a manner to grow young again, a kind of artificial Diſeaſes might be procured by means of ſtrict emaciating Diets: but more of this hereafter[s].

[s] See below, *Sect.* VIII. *ad finem.*

SECT.

SECT. VIII.

The History of INTENTIONS; *with a View to the* forming of practical Rules *for the* Prolongation of LIFE; *in pursuance of the twelfth, thirteenth, and fourteenth* Articles *of the* Table of Enquiry.

Transition.

HAving now finiſhed our *Enquiry*, with regard to the Objects; *viz.* inanimate, vegetable, animal and human Bodies, we muſt come cloſer; and conduct the Remainder by *Intentions*, which, in our own Judgment are juſt, proper, and, as it were, the real Paths of mortal Life. But nothing of moment has hitherto been performed on this Head; Mens Thoughts about it having all along been trifling and unprofitable. Some talk of comforting the natural Heat, and the radical Moiſture; of Foods, that make a laudable Blood, neither aduſt nor phlegmatic; of cooling and refreſhing the Spirits, *&c.* And we take them for well-meaning Men that talk thus: but all this makes little to the purpoſe. Another Party crys up Medicines prepared from Gold, as from a Body incorruptible; and from Gems, for recreating the Spirits by their Heat and occult Properties. They add, that if the Balms and Quinteſſences of Animals could be received, and contained in Veſſels, there would be great hopes of Immortality: That the Fleſh of Vipers, and of Deer, by a certain Conſent, have a Power to renew Life; becauſe the one caſts the Skin, and the other the Horns. They likewiſe abound in ſtill ſtranger Accounts, of an Ointment found buried under Ground, which a Man by uſing to his whole Body, except the Soles of his Feet, thence lived without any Diſtemper, (except ſome Swellings on the Soles of his Feet) to the Age of three hundred: and that *Artefius* growing old, tranſplanted the Spirit of a young Man into himſelf; and thus by the Death of another, continued alive for many Years. Others ſpeak much of ſucceſsful Hours, according to the Horoſcope of the Heavens, for collecting and preparing Medicines deſtined to prolong Life; they talk of *planetary Seals*, whereby to bring down and derive celeſtial Virtues for the ſame purpoſe; with numerous other the like fabulous and ſuperſtitious Stories: inſomuch that we ſtand amazed how Men ſhould be ſo infatuated as to believe ſuch Abſurdities; and cannot help commiſerating the hard Fate of Mankind, in being beſet and preſſed on all ſides with things vain and uſeleſs. But for our own *Intentions*, we have hopes that they cloſe in with things themſelves, without any tincture of Fiction, Vanity, or Credulity; and take them to be ſuch, that tho numerous Particulars may be found by Poſterity to anſwer them, yet no great Additions can

can be made to the *Intentions* themſelves. But before we proceed, we muſt offer a few Admonitions, of the utmoſt importance to Mankind.

Admonitions.

1. And firſt we judge, that the Offices of Life are preferable to Life itſelf; and therefore, tho there ſhould be any thing that might better anſwer our Intentions, but with Injury to Society, we abſolutely reject it. Things of this kind we may perhaps mention; but never inſiſt upon. Thus we have no ſerious and labour'd Diſcourſe upon Men's leading their Lives in Caves, free from the Inclemencies of the Air; upon perpetual Bathing in prepared Liquors; covering the Body with adventitious Skins, or Oil-clothes; daubing it over with a thick Coat of paint; the Inſtitution of a ſtrict and exact Regimen and Diet, with no other Deſign than to prolong Life; or the like monſtrous, nauſeous, and incommodious Methods: but produce only ſuch Remedies and Rules as neither diſturb the Duties and Affairs of Life, nor clog them with Delays and Difficulties.

2. Secondly, we earneſtly beſeech Mankind to trifle no longer, or imagine that ſo great a Work as to ſtop and turn back the powerful courſe of Nature, ſhould be performed by a Mornings-draught, or the Uſe of a coſtly Medicine; but to hold it for certain, that a Work of this kind is a laborious Undertaking, which requires a number of Remedies, properly ſuited to each other; for no one ſurely can be ſo dull as to believe, that what was never yet done, ſhould be effected but by Means never tried before.

3. We expreſly declare, that ſome of the things we ſhall propoſe were never experienced by us; nor would our courſe of Life allow thereof; but that they are derived with great Juſtneſs, as we judge, from our Principles and Poſitions, as Parts dug and cut off from the Rock or Mine of Nature: being extremely cautious to propoſe no Remedies but what are at leaſt ſafe, if not effectual.

4. We deſire Men would obſerve and diſtinguiſh, that the ſame things do not always contribute both to a healthy and a long Life; for there are ſome of ſervice in procuring chearfulneſs of Spirits, ſtrength and vigour of the Faculties, and yet ſhorten the courſe of Life. There are alſo other things very conducive to long Life, tho with ſome danger to the Health, unleſs prevented by ſuitable Means: whereof we ſhall not omit to give our Intimations and Cautions occaſionally.

5. We think proper to propoſe various Remedies, ſuitable to each *Intention*; leaving the Choice thereof, and the order of their Application, to Diſcretion: ſince it would be too tedious and improper, to publiſh particular Directions for different Conſtitutions of Body, or the various kinds of Life, and Ages; ſo as to ſhew what Methods are moſt agreeable to each; in what Order one thing is to be taken after another; and how the whole Praxis and Regimen is in every caſe to be conducted and obſerved.

6. In our *Table of Enquiry* we have laid down three general *Intentions*; viz. The *prevention of Waſte*; the *perfecting of Recruit*; and the *renovation of Decay*: but as what we have to propoſe upon theſe Heads is real Matter, not Words, we ſhall draw out the three *Intentions* into ten Operations; *viz.*

(1.) *The*

(1.) *The Operation upon the Spirits, with a View to their Rejuveneſcency.* (2.) *The Operation for excluding the Air.* (3.) *The Operation upon the Blood; and the beſt Heat for Sanguification.* (4.) *The Operation upon the Juices of the Body.* (5.) *The Operation upon the Viſcera, for protruding the Aliment.* (6.) *The Operation upon the external Parts, for attracting the Aliment.* (7.) *The Operation upon the Food itſelf, for making it inſinuate.* (8.) *The Operation upon the laſt Act of Aſſimilation.* (9.) *The Operation for mollifying the Parts, after they begin to dry.* And, (10.) *The Operation for diſcharging the old Juices, and ſupplying their place with new.* The four former relate to the firſt *Intention*; the four next to the ſecond; and the two laſt to the third *Intention.* And as this *Enquiry of Intentions* is directed to Practice; we ſhall now compriſe *Experiments*, *Obſervations*, *Admonitions*, *Remedies*, the *Explanation of Cauſes*, *Poſitions*, and whatever belongs to the Subject, under the Name of *Hiſtory* [h].

I.

The Hiſtory of operating upon the Spirits; *ſo as to renew, and continue them in a young, and vigorous State.*

1. THE Spirits are the Agents and Fabricators that produce all the Effects in the Body; as appears from numberleſs Inſtances. *The Office of the Spirits.*

2. If new and young Spirits could be put into an old Body; 'tis probable that this grand Wheel might give Motion to the reſt, and turn the Courſe of Nature back.

3. In all Conſumption, whether by Fire or Age, the more the Heat or the Spirit of the Subject preys upon the Moiſture, the leſs durable that Subject becomes; as is every where plain and obvious.

4. The Spirits are to be put into ſuch a Temper and degree of Activity, as not to drink and drain, but barely to ſip the Juices of the Body.

5. There are two kinds of Flame, the one briſk but feeble; which conſumes and evaporates light Bodies, as Straw or Shavings, without much affecting the harder: the other ſtrong and conſtant; which exerts a Force even upon hard and obſtinate Subjects; as large Wood and the like. *Two kinds of Flame.*

6. A briſk but weak Flame drys Bodies up, and renders them hard, decay'd and juiceleſs; and a ſtronger ſoftens and diſſolves them.

7. Some diſcutient Medicines alſo breathe out only the thinner Parts in Tumours, and therefore indurate; whilſt others diſcuſs more powerfully, and therefore ſoften. *Effect of diſcutient Medicines.*

8. So ſome purging and deterſive Remedies ſuddenly carry off the more fluid Parts; whilſt others draw away ſuch as are more obſtinate, and viſcous. *Purging Medicines.*

[h] Obſerve, that the whole was afterwards intended to be adjuſted, recompoſed, verified, and improved, according to the Directions given in the ſecond Part of the *Novum Organum.*

9. The

The Temper required in the Spirits.

9. The Spirits ſhould be poſſeſs'd of ſuch a Heat as fits them rather to prey upon and undermine the hard and ſtubborn Parts, than to diſcharge and carry off ſuch as are fine and prepared: for by this means the Body remains freſh and firm.

10. The Spirits ſhould be ſo prepared and wrought as to become denſe in their Subſtance, and durable in Heat, without growing ſharp; of ſuch a Quantity as ſuffices for the Offices of Life, without Redundancy; and of an eaſy, equable, and not ſubſultory Motion.

Effects of Vapours.

11. 'Tis manifeſt that Vapours have a great Effect upon the Spirits, from the Sleep, the Intoxication, the melancholy and mirthful Paſſions they procure; and the recovery of Perſons in fainting Fits, by Odours.

The Spirits condenſed four ways, viz.

12. The Spirits are condenſed four ways; *viz.* (1.) By Flight; (2.) By Cooling; (3.) By Appeaſing; and, (4.) By Quelling. And firſt for the Condenſation by *Flight*.

(1.) By Flight.

13. (1.) Whatever compreſſes on all ſides, drives the Body towards its Centre, and therefore condenſes.

Virtues of Opium and Opiates.

14. *Opium* is an exceeding powerful and effectual Remedy, for condenſing the Spirits by Flight or Compreſſure; and next to this, other Opiates and ſoporiferous Medicines in general.

15. The Virtue of Opium is very remarkable for condenſing the Spirits; as about three Grains thereof may preſently ſo coagulate or drive them together, that they ſhall not recover; but be ſuffocated and rendered immoveable.

16. Opium, and the like Medicines, do not put the Spirits to Flight by their Coldneſs; for they contain Parts that are manifeſtly warm: but on the contrary, cool by putting the Spirits to Flight.

17. This Flight of the Spirits by Opium and Opiates, appears clearly from the external Application thereof; upon which the Spirits immediately withdraw themſelves, and return no more: but leave the Part to gangrenate and mortify.

18. Opiates give eaſe in violent Pains; as in thoſe of the Stone, or the amputation of a Limb; principally by putting the Spirits to Flight.

19. Opiates have a good Effect from a bad Cauſe: for to diſturb the Spirits from their Seat is bad; but the Condenſation of them by that Diſturbance is good.

20. The *Greeks* laid great ſtreſs upon Opiates, both for the preſervation of Health and the prolongation of Life; and the *Arabians* ſtill more: inſomuch that their capital Medicines have Opium for the Baſis and principal Ingredient; with the Addition of other things to abate and correct its noxious Qualities, as in *Venice-Treacle*, *Mithridate*, &c.

21. Whatever is ſucceſsfully uſed in the Cure of peſtilential and malignant Diſeaſes, to check and curb the Spirits, and keep them quiet, may be advantageouſly transferred to the prolongation of Life; as the ſame thing, *viz.* the Condenſation of Spirits, is effectual in both Caſes: and this End is chiefly procured by Opiates.

22. The

22. The *Turks* find Opium, even in a large Quantity, innocent and cordial; insomuch that they take it before they go to Battle, as a means of inspiring Courage: but to us 'tis mortal, unless in a small Dose, and well corrected.

23. *Opium* and Opiates are found to excite Venery; which manifests their Power of strengthning the Spirits.

24. The distilled Water of wild Poppy is successfully given in Surfeits, Fevers, and many other Distempers; being, no doubt, a mild kind of Opiate. And let no one wonder that such a Medicine should be used for various purposes; this being the Privilege of Opiates; because, when the Spirits are corroborated and condensed they are able to resist any Distemper.

Coffee.

25. The *Turks* use a kind of Berry called *Coffee*; which they roast, powder, and make into an Infusion with hot Water. The drinking of this, they affirm, adds Strength and Vigour both to the Mind and Body; tho when taken immoderately it disorders the Senses: whence it appears to be a kind of Opiate.

Betel.

26. A certain Root called *Betel* is celebrated over all the East; the *Indians*, and others, accustoming themselves to chew and hold it in their Mouth; whereby they are wonderfully refreshed, enabled to endure fatigue, throw off Disorders, and strengthen'd for Venery. This also seems a kind of Narcotic; for it gives a great Blackness to the Teeth.

Tobacco.

27. The Use of *Tobacco* has spread very wide in our Time; and gives a secret Delight to those who take it; insomuch that the Presons once accustomed thereto find a Difficulty to leave it off: and doubtless it contributes to alleviate Fatigues, and discharge the Body of Weariness. 'Tis also commonly said to open the Passages; and draw off Humours. But its Virtues may be more justly attributed to its condensing the Spirits; as being a Species of Henbane; and, like Opiates, manifestly disturbing the Head.

28. There are sometimes Humours generated in the Body, which themselves act like Opiates; as we find in some kinds of Melancholy, those who are affected therewith proving very long-lived.

The simple Opiates.

29. The *Simple Opiates*, called also *Narcotics* and *Stupefactives*, are *Opium* itself, that is, the exhaled Juice of Poppy; both the *Poppies*, as well the Plant as the Seed, *Henbane*, *Mandrake*, *Hemlock*, *Tobacco*, and *Nightshade*.

The compound Opiates.

30. The *Compound Opiates* are the *Laudanums*, *Venice-Treacle*, *Mithridate*, *Diascordium*, *Philonium*, the *Hounds-tongue Pill*, the *Storax Pill*, and *Diacodium*.

Rules for prolonging Life by Opiates.

31. From what is before laid down may be deduced certain Directions, or Rules for the prolongation of Life, with regard to this *Intention* of condensing the Spirits by Opiates.

An opiate Diet.

32. For example: from the time of full Growth, let an opiate Diet be instituted yearly, and entered upon about the end of *May*; because the Spirits are most dissolved and attenuated in the Summer; and the Danger is then the less from cold Humours: but let the Opiate employ'd be a commanding one; tho weaker than those in use, as receiving a less proportion of *Opium*, and a more sparing addition of the very hot Ingredients. Let it be

taken in the Morning; ſleeping upon it. The Diet ſhould, at this time, be ſimple and ſparing; without Wine, Spices, or any thing ſweating. Let the Medicine be taken only every other Day; and continued for a Fortnight. And the Deſign of this Rule, in our Judgment, duly anſwers the Intention.

Opiate Fumes.

33. Opiates alſo may be received not only by the Mouth, but in the way of Fumes; tho this ſhould be done in ſuch a manner as not greatly to affect the expulſive Faculty, or drain off the Humours; but for a ſhort time only, to operate upon the Spirits in the Brain: and therefore, in a Morning, a Suffumigation, of Tobacco, mixed with *Lignum Aloes*, dried Roſemary, and a little Myrrh, received a-while at the Mouth and Noſtrils, may be of ſervice.

Diſtilled Waters of Opiates.

34. For the capital Opiates, ſuch as *Venice-treacle* and *Mithridate*, 'twere proper, eſpecially in Youth, to uſe the diſtilled Waters thereof, rather than the Medicines themſelves; becauſe the Vapour of the Medicine riſes, and its Heat is greatly kept back by Diſtillation: for diſtilled Waters are generally excellent in the Virtues that riſe by Vapour; but poor and weak in other reſpects.

Opiates inſpiſſating the Spirits.

35. There are Medicines which have a certain feeble, ſecret, and therefore ſafe opiate Virtue. Theſe yield a copious, but ſluggiſh, and not malignant Vapour, as other Opiates do; and therefore put not the Spirits to Flight, but only collect and ſomewhat thicken them.

The milder Opiates, or Subſtitutes for the ſtronger.

36. The milder Opiates, or Subſtitutes for the ſtronger, are principally *Saffron*, the *Indian-leaf*, *Ambergreaſe*, *Amomum*, *Pſeudamomum*, *Lignum Rhodium*, *Orange-flower Water*; but much rather an Infuſion of the freſh Flowers in Oil of Almonds.

37. Tho the *ſtronger Opiates* are to be uſed but very ſparingly, and at certain times; this milder ſort may be uſed common, and in daily Diet: and they contribute greatly to prolong Life. An Apothecary of *Calicut*, is, by the Uſe of *Ambergreaſe*, reported to have lived a hundred and ſixty Years; and the Nobility of *Barbary* are, by the Uſe thereof, found to be long lived; whilſt the common People there are but ſhort lived. And our Anceſtors, who made a frequent Uſe of *Saffron* in their Cakes, their Broths, *&c.* lived much longer than we do. And ſo much for the *Condenſation of the Spirits* by *Opiates*, and their Subſtitutes.

Saffron.

(2.) The Condenſation of the Spirits by Cold.

38. (2.) We come now to the *ſecond* manner of condenſing the Spirits; *viz.* by *Cold*. And firſt, Condenſation is the proper Effect of Cold; and performed without any Malignity or unfriendly Quality: whence its Operation is ſafer than that of Opiates, tho ſomewhat leſs powerful, if uſed only by turns, as Opiates are: but as it may be employ'd familiarly and with moderation ordinarily, it has a much greater Effect than Opiates in the prolonging of Life.

The Spirits cooled three ways.

39. The Spirits are cooled three ways; *viz.* (1.) By Reſpiration. (2.) By Vapour. And, (3.) By Aliment. The *firſt* is the principal, but ſomewhat out of our command; the *ſecond* alſo is powerful, and within our compaſs; but the *third* is weak and ſlow.

40. A

40. A clear and pure Air that has nothing fuliginous, nor felt much of the Sun's Heat before 'tis received into the Lungs, excellently condenſes the Spirits. And ſuch an Air is found on the dry tops of Mountains, or in open Champains, that are bruſhed by the Wind, but ſcreened from the Sun. *By the Air.*

41. As to the cooling and condenſing of the Spirits by Vapours; we place the Foundation of this Operation in *Nitre*, as a Subject choſen and peculiar to this end, for the following Reaſons. *Nitre.*

42. *Nitre* is a kind of cold Aromatic, as appears from the Senſe itſelf; for it bites and vellicates the Tongue and Palate with Cold, as Spices do with Heat; and is the only thing, that we know of, which has this Property. *Its Nature, and Effects.*

43. All cold Bodies that are properly, and not accidentally cold, as *Opium*, contain but little, and a jejune Spirit; whilſt, nearly all the hot Bodies are full of Spirit. *Nitre* is the only Body in the vegetable Kingdom that, tho cold, abounds with Spirit; for *Camphire*, which is ſpirituous, yet performs the Actions of Cold, refrigerates only by accident; *viz.* by its Tenuity, without Acrimony, and by promoting Perſpiration in Inflammations.

44. In the congelation and freezing of Liquors, lately introduced by the Application of Snow and Ice without-ſide the containing Veſſel, *Nitre* is uſed as an Ingredient; and doubtleſs both excites and ſtrengthens the freezing Power. 'Tis true, common Bay-ſalt is uſed for the ſame purpoſe; but this rather actuates the Cold of the Snow or Ice, than gives a Coldneſs of itſelf. But I have been told, that in the hotter Regions, where no Snow falls, Congelation has been performed by Nitre alone: tho this is not hitherto verified [i].

45. Gunpowder, whereof Nitre makes the principal Ingredient, is reported, when drank, to inſpire Courage, and to be frequently taken by Sailors and Soldiers before Battle; as *Opium* is by the *Turks*.

46. *Nitre* is ſucceſsfully given in Calentures, and peſtilential Fevers; to ſuppreſs and cool their deſtructive Heats.

47. 'Tis very manifeſt from Gunpowder, that *Nitre* has a great Averſion to Flame; whence proceeds that ſurprizing Ventoſity and Exploſion.

48. *Nitre* is found to be, as it were the Spirit of the Earth; for 'tis certain that any clean Earth, unmix'd with nitrous Bodies, thrown on Heaps, and kept covered and ſcreened from the Sun, ſo as to afford no Vegetables, will copiouſly collect *Nitre:* whence 'tis manifeſt, that the native Spirit of Nitre is of a lower rank than the Spirit of Animals, or even of Vegetables.

[i] I ſuppoſe this is meant of the Coolneſs which Nitre communicates to Water, during the time it continues diſſolving therein. But does not the Act of Congelation require *Sal-armoniac* inſtead of Nitre; and a ſecond or third repetition of the Solution, after both the Salt and the Water have remained in the former Solutions, to acquire their degrees of Cold reſpectively? For ſcarce any Salt will produce Ice upon being barely diſſolved in the Water of a warm Climate; unleſs the Water be conſiderably cooled before. See *Sylva Sylvarum*, under the Articles, COLD, COOLNESS, and HEAT.

49. Animals that drink nitrous Water grow manifeſtly fat; which is a ſign of Coldneſs in *Nitre* [k].

50. Land is beſt improved by nitrous Bodies; and all Manure is nitrous; which ſhews there is a Spirit in *Nitre*.

51. From all which 'tis plain, that the human Spirits may be cooled and condenſed by the native Spirit of *Nitre*; and at the ſame time rendered more denſe and leſs conſuming: and therefore, as ſtrong Wines, Spices and the like inflame the Spirits and ſhorten Life; ſo *Nitre*, on the other hand, compoſes and condenſes them, and conduces to Longevity.

How Nitre may be uſed.

52. *Nitre* may be uſed at Meals, mixed along with nine Parts of Table-ſalt; it may alſo be taken with the Breakfaſt or Mornings-draught, from three Grains to ten: but in what way ſoever it be moderately uſed, 'tis highly conducive to long Life.

The Subſtitutes for Nitre.

53. As *Opium* ſtands firſt in Virtue for condenſing the Spirits by Flight, and has its leſs powerful but ſafer Subalterns; which may be taken in larger Doſes, and with greater frequency: ſo *Nitre* likewiſe, which ſtands firſt for condenſing the Spirits by Cold, or rather by cooling and refreſhing them at once, has its Subſtitutes.

54. The Subſtitutes for *Nitre*, are thoſe things which yield an Odour ſomewhat earthy; as that of clean and good Earth, newly broke or turned up with the Plough or Spade. Among the principal of theſe are *Borage*, *Bugloſs*, *Langue de Bœuf*, *Burnet*, *Strawberry the Fruit and Leaf*, *Raſberries*, raw *Cucumbers*, raw *Apples*, *Vine-leaves*, *Vine-buds*, and *Violets*.

55. Next to theſe come ſuch as have a certain greeneſs or rawneſs of Smell, with ſome tendency to warmth, yet not without a cooling Property; as Balm, green Lemmons, green Oranges, Roſe-water; the pale, the damaſk, the red, and the muſk Roſe.

56. Let it be obſerved, that the Subſtitutes for *Nitre*, generally anſwer the Intention better in a crude State, than after having felt the Fire; becauſe the cooling Spirit is diſſipated by Heat: whence they are beſt taken, either infuſed in Liquor, or without Preparation.

57. As the Spirits are ſomewhat condenſed by the Subſtitutes for *Opium*, ſo likewiſe are they by the Odour of the Subſtitutes for *Nitre*; ſo the ſmell of freſh and clean Earth, received either by following the Plough, or by digging or by weeding in the Garden, excellently compoſes the Spirits; which are likewiſe finely refreſhed by the ſcent of the Leaves that toward the end of Autumn fall in the Woods and Hedges; but above all, by the Breath of a dying Strawberry-bed: and the Odour of Violets, Wall-flowers, Bean-bloſſoms, Sweet-briar, and Honey-ſuckles, has a like Effect whilſt they are growing. And I knew a certain Nobleman of a great Age, who, as ſoon as he awaked in the Morning, had a piece of freſh Earth every Day brought him, in order to receive its Odour.

58. And no doubt but the Blood being cooled and tempered by ſuch cold Plants as *Endive*, *Succory*, *Purſlain*, *&c.* might conſequently cool the Spirits; but

[k] Where are theſe nitrous Waters found? or what is here properly meant by *nitrous Waters*?

but this is a ſlow and indirect way; whereas Vapours operate immediately. And ſo much for the Condenſation of the Spirits by Cold.

59. (3.) The third kind of *Condenſation* is by *appeaſing the Spirits.* Now the Spirits are appeaſed by ſuch things as prove grateful and acceptable to them, without exciting or calling them out too much; but rather incline them to Complacency and Self-ſatisfaction, and to keep themſelves within their own Sphere. But the Particulars of this Enquiry are already ſatisfy'd by what is above delivered upon the Subſtitutes for *Opium* and *Nitre.* (3.) *By appeaſing the Spirits.*

60. (4.) And for the fourth kind of *Condenſation*; *viz.* by quelling the too great Vigour, and checking the Impetuoſity of the Spirits, we ſhall ſpeak to it below, when we come to enquire into their Motions [l]. So that having already ſpoke to their Condenſation, which regards the Subſtance of them; we next proceed to their degree of *Heat.* (4.) *By checking their Impetuoſity.*

61. 'Twas before obſerved, that the Heat of the Spirits ſhould be neither great nor conſuming; but ſuch as rather fits them to prey upon the hard reſiſting Parts, than to carry off the light and fine ones [m]. *The degree of Heat beſt ſuited to the Spirits.*

62. Spices, Wine, and ſpirituous Liquors muſt be guarded againſt, and uſed with great moderation, and with intervals of Abſtinence. The ſame Caution reaches to Thyme, Marjoram, Penny-royal, and all hot and inflammatory Plants, which impart not a recruiting, but a predatory Heat to the Spirits. *Aromaticks to be ſparingly uſed.*

63. But a prudent and judicious Uſe of theſe Simples, ſometimes by way of Food, and ſometimes by way of Phyſick, will anſwer this Intention; *viz. Ellicampane, Carduus Benedictus*, young *Creſſes, Germander, Angelica, Zedoary, Vervain, Valerian, Myrrh, Coſtmary, Elder-flowers*, and *Chervil.* *The milder ſort to be preferred.*

64. It happens fortunately alſo, that the capital *Opiates* are of excellent Uſe in this Operation; as by Compoſition they afford ſuch a Heat as is wiſhed for, but ſcarce found in Simples; for by mixing together ſuch hot things as *Euphorbium, Pellitory, Birthwort, Opopanax, Ammoniacum, Galbanum*, &c. to blunt the narcotic Virtue of the Opium, Phyſicians make the Medicines here required; as is excellently ſeen in the *Theriaca, Mithridate*, &c. which are not biting and pungent to the Tongue, but only ſomewhat bitter, and of a ſtrong Scent, exerting their Warmth in the Stomach, and the ſubſequent Paſſages. *The capital Opiates.*

65. A frequent Excitation to Venery, but rarely performing the Act, conduces alſo to give the Spirits a robuſt Heat; and the like may be ſaid of ſome other Paſſions: of which hereafter. And ſo much for the Heat of the Spirits diſpoſing to long Life. *Frequent Excitation to Venery.*

66. As to the *Quantity of the Spirits*, with a View to keep them down, and prevent their over Proportion, 'tis but a ſhort Enquiry; ſince a ſmall Flame does not devour ſo much as a large one. *The Quantity of the Spirits.*

67. It ſeems confirmed by Experience, that a ſlender and almoſt *Pythagorean*, monaſtic, or hermetic Diet, regulated by Penury and Want, conduces to Longevity. Such a Regimen turns upon the drinking of Water, lying hard, the uſe of a cold Air, eating of Herbs, Fruits, dried Fleſh, and dried *Monaſtick Life.*

[l] See below, § 70—74, and 86—94.
[m] See above, § 4.

dried Fiſh, wearing of Hair-ſhirts next the Skin, frequent Faſting, frequent Watching, few ſenſual Pleaſures, *&c.* all which diminiſh the Spirits, and reduce them to a Quantity barely ſufficient to ſupport the Offices of Life; whence they are rendered leſs predatory.

One a little leſs ſevere.

68. But if the Regimen be not altogether ſo rigorous and mortifying, yet continually equable and uniform, it has the ſame Effect; as a greater Flame, when uniform and undiſturb'd, conſumes leſs of its Subject, than a ſmall one agitated ſtronger, and weaker by Fits. And we have an eminent Example of this in the Regimen and Diet of *Cornaro* the *Venetian*; who for many Years continued to eat and drink by exact Weight: thus preſerving himſelf in full ſtrength of Body, and vigour of Senſes, to more than a hundred Years.

Seaſonable uſe of Venery.

69. Regard likewiſe muſt be had, that the Body which is nouriſhed to the full, and not emaciated by the ſtrict Regimen above-mentioned, omit not the ſeaſonable uſe of Venery; leſt the Spirits ſhould grow too turgid, and thus ſoften and relax the Body. And ſo much for the moderate and frugal Quantity of the Spirits.

The Motion of the Spirits check'd three ways.

70. Next follows the Enquiry of checking the Motions of the Spirits; for Motion manifeſtly tends to attenuate and over-heat them. They are checked three ways, *viz.* (1.) By Sleep; (2.) By avoiding vehement Labour, immoderate Exerciſe, and Laſſitude; and, (3.) By bridling all troubleſome Paſſions. And firſt of Sleep.

Viz. (1.) *By Sleep.*

71. The Fable goes of *Epimenides*, that he ſlept many Years in his Cave without eating; for the Spirits waſte and prey but little in Sleep: and Experience ſhews that Dormice, Bats, Swallows, *&c.* ſhut up in cloſe Places, ſleep the whole Winter: the ſame is alſo ſuppoſed of Bees and Drones, tho ſometimes deſtitute of Honey; and again of Butter-flies, Flies, *&c.*

72. Sleep in the Afternoon is good for the Spirits; as no unfriendly Vapours then aſcend to the Head, and only the firſt light Dew of the Meal; tho in all other Reſpects with regard to Health, 'tis pernicious and oppreſſive: but in extreme old Age, both Meals and Sleep ſhou'd be frequent, tho ſhort and ſmall; and in the laſt Stage of a long Life, perpetual Reſt and Repoſe are ſerviceable, eſpecially in the Winter. And as moderate Sleep contributes to prolong Life; it does it ſo much the more where it is pleaſing, and not broken or diſordered.

73. Quiet Sleep is procured by Violets, Lettuce, eſpecially boil'd; Saffron, Balm, Apples eat at going to Bed; Toaſt and *Malmſey*, particularly if Muſk-roſes are firſt infuſed in the Wine. 'Twere therefore proper to compoſe a Pill, or ſome ſmall Draught of theſe Ingredients; and to uſe it often. Thoſe Things likewiſe which cloſe the Mouth of the Stomach, as prepared Coriander-ſeed, Quinces and roaſted Pears, cauſe pleaſing Sleep. But above all Things in Youth, eſpecially if the Stomach be ſtrong, a good draught of cold Water is proper at going to Bed.

Admonition.

As to the Buſineſs of *Trances*, whether voluntary or procured, and of intent and deep Thought, tho without Perturbation, we have nothing certain to offer; they may doubtleſs contribute to this Intention, and condenſe

denſe the Spirits more powerfully even than Sleep; as they lull and ſuſpend the Senſes as much or more than that: but of theſe Particulars let farther Enquiry be made. And ſo much for the Affair of Sleep.

(2.) *By regulating the Exerciſe.*

74. We next proceed to *Motion* and *Exerciſe*. Laſſitude is prejudicial: ſo is too ſudden and violent Motion and Exerciſe; as Running, Tennis, Fencing, and the like; ſo again is all endeavouring beyond the Strength, as in Leaping, Wreſtling, *&c.* 'Tis certain that when the Spirits are ſtrained, either by velocity of Motion, or by extreme Efforts, they afterwards become more predatory and conſuming. On the other Hand, the Exerciſes that require a moderately robuſt Motion, but not too quick, or beyond the utmoſt ſtrength; as Dancing, Shooting with the long Bow, Riding, Bowling, *&c.* are rather beneficial than hurtful.

(3.) *By governing the Paſſions.*

75. We now come to conſider the Affections and Paſſions of the Mind, to ſee which of them conduce to, and which of them prevent long Life. And firſt, extreme Joy attenuates and diſſipates the Spirits, and ſhortens Life; but familiar Chearfulneſs corroborates the Spirits without reſolving them.

Senſual Pleaſures.

76. Senſual Impreſſions of Delight are bad; but the Thoughts of Joys paſſing in the Memory, or the Apprehenſions of them in Hope, and Expectation, are good.

Joy.

77. A ſuppreſſion, or gradual communication of Joy, recreates the Spirits more than profuſe and ſudden Joy divulged all at once.

Grief.

78. Grief and Sadneſs, if unattended with Fear, and not too afflicting, prolong Life; for they contract the Spirits, and cauſe a kind of Condenſation.

Fear.

79. Great Fears ſhorten Life; for tho Grief and Sadneſs condenſe the Spirits, yet they cauſe only a ſimple Contraction; whilſt in Fear, by reaſon of the Sollicitude after the Remedy, and an intermixture of Hope, there is a kind of tormenting Flux and Reflux made of the Spirits.

Anger.

80. Anger, when ſuppreſs'd, is alſo a kind of Torture, and cauſes the Spirits to prey upon the Juices of the Body; but when it has vent and breaks out, it becomes of ſervice; as thoſe Medicines do which procure a robuſt Heat.

Envy.

81. Envy is the worſt of Paſſions, and feeds upon the Spirits, and theſe again upon the Body; the more becauſe 'tis a laſting Paſſion; and as the Expreſſion goes of it, keeps no Holy-days.

Pity.

82. Pity for the Misfortunes of others, which ſeem not likely to fall upon ourſelves, is good: but that, which by a kind of Similitude may reflect upon the pitying Perſon is bad; on account of the Fear it excites.

Shame.

83. Moderate Shame hurts not, as it ſomewhat contracts and again diſperſes the Spirits; inſomuch that baſhful Perſons are generally long lived: but Shame ariſing from ſome great Ignominy, and continuing long to afflict, contracts the Spirits even to Suffocation, and is deſtructive.

Love.

84. Love, if ſucceſsful, and not deep, is a Species of Joy, and comes under the Rules above laid down of that.

85. Hope,

Hope.

85. Hope, is of all the Paſſions the moſt advantagious, and greatly contributes to prolong Life; if it be not too often diſappointed, but entertains the Imagination with a Proſpect of Good: whence they, who fix and propoſe to themſelves any End as the Purſuit of their Life, and conſtantly advance by degrees therein, are generally long lived; but coming at length to the top of their Hopes, and having nothing further to expect, they commonly languiſh and die ſoon after; ſo that Hope may ſeem a kind of Leaf-joy, and like Gold, extremely ductile.

Miſcellaneous Obſervations upon the Spirits.

86. Admiration and moderate Contemplation have a great Power to prolong Life; for theſe detain the Spirits upon pleaſing Subjects, without ſuffering them to tumultuate and act diſorderly: whence all the Contemplators of natural Things, who had ſo many and ſuch great Objects of Admiration; as *Democritus*, *Plato*, *Parmenides*, and *Apollonius* were long lived. So likewiſe were the Rhetoricians, tho they only taſted ſuch Subjects, and purſued the Light of Diſcourſe rather than the Darkneſs of Things; as *Gorgias*, *Protagoras*, *Iſocrates*, *Seneca*. And indeed as old Men are generally pratling and talkative; ſo great Talkers very often live to be old: for this is a ſign of ſlender Contemplation, which does not much affect or torture the Spirits; but ſubtile, acute and ſevere Enquiries cut Life ſhort; for theſe fatigue and wear out the Spirits. And ſo much for the motion of the Spirits from the Paſſions of the Mind; whereto we will add a few general Obſervations upon the Spirits, that fall not under the preceding diviſion.

The Spirits not to be diſſolved.

87. Particular Care muſt be had, that the Spirits be not often diſſolved; for Rarefaction precedes Diſſolution: and the Spirits once rarefied cannot eaſily recover themſelves, and become denſe again. The Spirits are diffuſed by hard Labour, vehement Paſſions of the Mind, profuſe Sweats, large Evacuations, warm Bathing, and the immoderate or unſeaſonable uſe of Venery; again, by too great Cares, anxious Diſquietudes and Expectations; and laſtly by malignant Diſeaſes, and ſevere Pains and Tortures of the Body; all which are, as much as poſſible, to be avoided.

How refreſhed.

88. The Spirits are refreſh'd by Things whereto they are both accuſtom'd and unaccuſtom'd. It ſtrangely conduces to preſerve the Vigour of the Spirits, not to uſe cuſtomary Things to Satiety, nor new ones before a ſtrong and vigorous Appetite requires them; and therefore Cuſtoms are to be broke off with Judgment and Diligence before Averſion comes on; and the deſire of Change is to be reſtrain'd for a time, till become ſtrong and vigorous. The courſe of Life muſt likewiſe be ſo ordered, as to have many and various Renovations; that the Spirits may not grow ſluggiſh by perpetually converſing with the ſame Things. For altho *Seneca* ſharply ſaid, *the Fool is always beginning to live*; yet this Folly, and numerous others, are conducive to long Life.

The Spirits to be regulated.

89. It muſt be obſerved, contrary to what is uſually done, that when Men perceive their Spirits to enjoy a good, a ſound and a pleaſing State, which appears from a greater Tranquillity and Pleaſure of Mind, they are then to cheriſh and not to change them; but when they are in a reſtleſs and diſ-

orderly ſtate, which alſo appears from Melancholy, Indolence, and other Indiſpoſitions of the Mind, they are ſometimes to oppreſs and alter them. Now the Spirits are preſerved in the ſame ſtate, by reſtraining the Paſſions, moderating the Diet, abſtaining from Venery, and by uſing moderate Labour, and moderate Reſt. They are altered and oppreſs'd by the contrary; *viz.* vehement Paſſions, Gluttony, immoderate Venery, hard Labour, intenſe Thinking, and much Buſineſs. But 'tis the practice of Men, when they are chearful, and beſt pleas'd with themſelves, then moſt to affect and purſue Feaſting, Venery, Labour, Difficulties, and Buſineſs. Whoever deſires to prolong Life, muſt act in a contrary manner; and endeavour to ſupport and preſerve the good Condition of his Spirits; and diſcharge and change them when ill diſpoſed.

How refreſhed in Age.

90. 'Tis well obſerved by *Ficinus*, that old Men, to refreſh their Spirits, ſhould frequently recollect and ruminate upon the Actions of their Youth and Childhood: and certainly ſuch kind of Remembrance is, as it were, the peculiar recreation and delight of old Men; whence 'tis pleaſant for Men to enjoy the Company of thoſe they were educated with; and to viſit the places where they were brought up. And *Veſpaſian* gave ſo much into this Humour, that when he was Emperor, he cou'd not prevail upon himſelf to quit his Father's homely Houſe; for fear of loſing his accuſtom'd Objects, or ſome part of the Memory of his Youth.

Old Men to retire from Buſineſs.

91. But the moſt grateful Thing to the Spirits is, a continual Progreſſion for the better; and therefore Youth and riper Years ſhou'd be ſo conducted as to leave new Comforts for old Age: the principal whereof is moderate Reſt; whence old Men in Poſts of Honour, offer Violence to themſelves, if they do not retire. Of this we have a remarkable Example in *Caſſiodorus*, who was of ſuch Authority among the *Gothick* Kings of *Italy*, as to be the Soul of their Affairs; but retiring to a Monaſtery at near the Age of eighty, he there continued to a hundred. But in this Reſpect two Cautions are required; the firſt is, that they wait not till the Body is quite wore out and diſtempered; for in that caſe all Change, tho for the better in appearance, haſtens Death: the ſecond, that they give not themſelves up to perfect Indolence, but have ſomething gratefully to amuſe their Thoughts and feed the Mind: to which purpoſe Letters are beſt ſuited; and next to theſe, Building and Planting.

Involuntary Studies waſte the Spirits.

92. Laſtly, one and the ſame Action, Study, or Labour, undertaken by Choice, and with a willing Mind, refreſhes the Spirits; but if againſt the Inclination, it waſtes and deſtroys them: 'tis therefore conducive to long Life, either that a Man ſo ſhape his Courſe by Art, as to have it free and according to his own wiſh; or elſe procure himſelf ſuch a pliable Temper, that whatever is impoſed upon him by Neceſſity, may rather lead than drag him.

The mouth of the Stomach to be regarded.

93. We muſt not omit, with regard to the Government of the Paſſions, that particular Care ſhould be had of the Mouth of the Stomach; but principally to keep it from being too much relaxed; becauſe this part has a greater influence over the Paſſions, eſpecially the daily ones, than either

the Heart or Brain ; excepting only ſuch as proceed from powerful Vapours, as in Drunkenneſs and Melancholy.

The preſent Enquiry why more diligently proſecuted.

94. And thus much for the *Operation upon the Spirits*, with a view to continue them in a flouriſhing and youthful ſtate : wherein we have uſed the greater Diligence, becauſe Phyſicians and other Writers ſcarce touch upon it ; but chiefly becauſe the Operation upon the Spirits, and making them young again, is the readieſt and ſhorteſt way to prolong Life, on account of two Abridgments ; the one, that the Spirits operate immediately upon the Body ; the other that Vapours and the Paſſions operate immediately upon the Spirits : ſo that theſe Things go directly, and in a ſtrait Line to the end ; whilſt others reach it by a Curve.

II.

The Hiſtory of the Operation for excluding the Air from the Body.

Excluſion of the Air has a double Tendency to prolong Life.

1. THE *excluſion of the Air*, has a double Tendency to prolong Life ; *firſt*, as after the native Spirit, it more than any other Thing preys upon the Juices, and haſtens the dryneſs of the Body ; ſo that how much ſoever Air may otherwiſe animate, and contribute to Health ; yet the ſhutting of it out, externally, conduces to Longevity.

2. The *ſecond* Effect, which follows upon excluding the Air, is much more deep and ſubtile ; for the Body being clos'd up, and not perſpiring, detains the included Spirit, and turns it into the harder Parts of the Body ; which therefore are kept ſoft and tender by the Spirit.

Bodies how dried.

3. The manner of this Action appears in the deſiccation of inanimate Bodies ; and 'tis a certain *Axiom*, that Bodies are dried by the Avolation of their Spirit ; but rendered ſoft and yielding by its Detention. It muſt likewiſe be allowed the property of all Heat, to moiſten and attenuate ; and to contract and dry only by accident.

The living in Caves,

4. To live in Caves and Dens, where the Air receives not the Sun's Rays, may conduce to Longevity ; as the Air of itſelf, without being animated by Heat, has no great Force to prey upon the Body. And if we go backwards, it will appear from many Remains and antient Monuments, that the Size and Stature of certain Men have been much larger ; and that theſe Men generally lived in Caves : and there is ſome Affinity between length of Age, and largeneſs of Limbs. We alſo ſuſpect the Life of the *Stylites*, or *Anchorites* of the Pillar, bore ſome reſemblance to a Life led in Caves ; their Bodies being ſecured, or skreened from the Sun's Heat ; and the Air they breathed not being ſubject to great Changes or Inequalities. Thus much is certain, that both the *Symeons*, and *Daniel*, and *Sabâ*, as well as other *Stylites*, were very long lived. And even the modern *Anchorites*, who were either immured, or ſhut up in Pillars, have frequently lived long.

5. Next

5. Next to the living in Caves, is living upon Mountains; for as the Sun's Heat penetrates not into Caves, it has but little Effect on the tops of Mountains, for want of Reflection. But this must be understood of Mountains where the Air is clear and pure, or where, by reason of the dryness of the Valleys, no Clouds or Vapours ascend; as in the Mountains round *Barbary*, where to this Day, Men often live to a hundred and fifty Years. *Living on Mountains.*

6. But tho the Air of these Caves or Mountains is not of its own nature considerably predatory; yet, as the Air we live in is rendered so by the Sun's Heat, the Body ought, as much as possible, to be secured against it. *The Body to be guarded against the Air.*

7. The Air may be excluded two ways; first by contracting the Pores, and again by filling them up. *Two ways of excluding the Air.*

8. For contracting or shutting up the Pores, the coldness of the Air itself is serviceable; so are uncovering of the skin, which hardens it; bathing in cold Water; and Astringents used externally, such as Mastich, Myrrh, Myrtle, *&c.* *By closing the Pores.*

9. But this Intention is much better answered by Baths (tho to be seldom used, especially during the Summer) consisting of such astringent mineral Waters, as may be safely drank; for Example, those of Chalybeate and vitriolic Springs; which powerfully contract the Skin. *Bathing.*

10. As for filling up the Pores; Paints and the like thick unctuous Bodies, or, what may be used with more Convenience, Oil and Fats preserve the Substance of the Body, as much as Oil-paint and Varnish preserve Wood. *Paints.*

11. The antient *Britons* painted themselves with Woad, and were very long lived; so likewise did the *Picts*; who are from thence thought by some to have derived their Name, which signifies painted Men. *Used by the Britons.*

12. The Inhabitants of *Brasil* and *Virginia* paint themselves to this Day, and are very long lived, especially the *Brasilians*; insomuch, that five Years since, the *French* Jesuits met with some of them who remember'd the Building of *Fernamburg*; a hundred and twenty years backwards; and yet were Men grown at the Building thereof. *Brasilians.*

13. *Johannes de Temporibus*, who is reported to have lived three hundred Years, being asked by what means he preserved himself, is said to have answered, by Honey within, and Oil without. *Johannes de Temporibus.*

14. The *Irish*, especially the Wild-*Irish*, are to this Day very long lived; and they report, a few Years ago, that the Countess of *Desmond* lived to a hundred and forty, and shed her Teeth three times: and 'tis a practice with the *Irish*, to anoint themselves with old salt Butter before the Fire. *The Irish.*

15. The *Irish* also were accustom'd to wear their Shirts and Linen stained with Saffron; which practice, tho first introduced to prevent Putrefaction, yet we judge it of the same Service in prolonging Life: for Saffron, of all the things we know, is the best for cherishing the Skin, and the Flesh; as it has a remarkable Astringency, Oiliness, and a subtile Heat, without Acrimony. And I knew an *Englishman*, who carried a Bag of Saffron about his Stomach in a Voyage, to conceal it and prevent paying the Duty; and tho at *The external use of Saffron.*

other times he uſed to be exceedingly Sea-ſick, he now continued perfectly well without the leaſt Retching.

Anointing with Oil.

16. *Hippocrates* adviſes to wear clean Linen next the Skin in the Winter, but foul and beſmeared with Oil in the Summer; the Reaſon whereof ſeems to be this, that the Spirits greatly exhale in the Summer; and therefore the Pores of the Skin are then to be fill'd up.

How to be practiſed.

17. We therefore judge that anointing the Skin with Oil, either that of Olives or ſweet Almonds, greatly conduces to long Life. And this ſhould be done every Morning upon riſing; and with Oil wherein a little Bay-Salt and Saffron is mix'd; but it ought to be laid on light, with Wooll, or a ſoft Sponge, not ſo as to run, but barely to bedew and moiſten the Skin.

18. 'Tis certain that Liquors, even ſuch as are oily, uſed in a large quantity, draw ſomewhat from the Body; but on the contrary are imbibed by it in a ſmall one: and therefore, as we ſaid, the Unction muſt be but ſlight and ſuperficial; or elſe let only the Shirt itſelf be a little rubbed with the Oil.

Whether uſed in this manner by the Antients.

19. It may here be objected, that this anointing with Oil, tho not uſed among ourſelves, has however been experienced, and left off by the *Italians*; and was antiently familiar, and a part of Regimen among the *Greeks* and *Romans*; yet Mankind in thoſe Ages were not longer lived than at preſent. To which it may be juſtly anſwered, that they uſed their Oil only after warm Bathing; unleſs we except their Gladiators and Wreſtlers; but warm Bathing is as contrary to this *Intention* of ours, as anointing is congruous; the former opening, but the latter blocking up the Pores: and therefore warm Bathing, without ſubſequent anointing is extremely bad for our purpoſe; but anointing without Bathing excellent. Their anointing alſo was uſed in the way of Delicacy, or at beſt to preſerve Health; but in no reſpect to procure long Life: whence they employ'd at the ſame time precious Unguents, which, tho grateful and pleaſing in themſelves, are prejudicial in our Intention, by reaſon of their Heat. Whence *Virgil* ſeems to have well obſerved, that the uſe of Oil was corrupted with Spices [n].

Anointing how healthy.

20. Anointing with Oil contributes to Health in the Winter, by excluding the Cold; and in Summer by keeping in the Spirits, and preventing their Diſſolution; as alſo by fencing againſt the force of the Air, which is then moſt predatory.

Four Cautions to prevent ill Effects from anointing.

21. As anointing with Oil is one of the moſt powerful Remedies for prolonging of Life, we ſhall here add a few Cautions about its Uſe, to prevent endangering the Health: and theſe Cautions are principally four, with regard to the four Inconveniences that may follow upon it.

viz.

Stopping the Sweat.

22. The *firſt* Inconvenience is, that by ſuppreſſing the Sweat, it may produce Diſtempers from excrementitious Humours; but this may be remedied by the uſe of Purges and Glyſters, ſo as to procure a proper Diſcharge; for 'tis certain, that Evacuation by Sweat has a general tendency to

[n] Nec *Caſiâ* liquidi corrumpitur uſus olivi.

to Health, but ſhortens Life; whilſt moderate Purgatives operate upon the Humours, and not, as Sweat does, upon the Spirits.

23. The *ſecond* Inconvenience is, that our anointing may ſometimes heat and inflame the Body; becauſe the Spirits when ſhut up, and not ſuffer'd to perſpire grow warm: but this is prevented by a cooling Diet, and the uſe of ſome proper Refrigerants at due Intervals; of which more in our next Enquiry into the Operation upon the Blood. *Heating the Body.*

24. The *third* Inconvenience is, that it may oppreſs the Head; as all external Obſtruction ſtrikes back the Vapours, and turns them upon that Part: but this is entirely prevented by Catharticks; eſpecially by Glyſters, and ſtrongly cloſing the Mouth of the Stomach with Aſtringents: again alſo by combing and rubbing the Head, along with the uſe of proper perſpirative Lixiviums; not omitting ſuitable Exerciſe, that ſome Perſpiration by the Skin may likewiſe be procured. *Oppreſſing the Head.*

25. The *fourth* Inconvenience is more ſubtile; *viz:* that the Spirits detain'd by cloſing up the Pores may ſeem to multiply too faſt; becauſe, as little exhales, and new Spirit is conſtantly produced, the quantity may increaſe too much; and ſo the Body come to be more prey'd upon: but this is not entirely the Caſe; for all Spirit ſhut up and not fann'd, becomes languid, like Flame unanimated by Air; whence it becomes leſs active, and leſs productive of new: but doubtleſs its Heat is thus increaſed, tho its Motion be retarded; which is likewiſe the Caſe of Flame. But this Danger may be prevented, by ſometimes mixing refrigerant Ingredients along with the Oil, ſuch as Roſes, and Myrtle; for no hot Things are here to be uſed. *Over increaſing the Spirits.*

26. It may be likewiſe ſerviceable to wear ſuch Garments as are ſomewhat unctuous or oily, and not aqueous; becauſe theſe exhauſt the Body leſs: ſuch are thoſe of Callico rather than Linen. And 'tis manifeſt, that the Spirits of odorous Bodies hang much longer in Woollen than Linen; and therefore tho Linen is more elegant and grateful to the Touch, yet we ſuſpect it for this Intention. *Woollen Garments prefer'd to Linen.*

27. 'Tis a practice among the wild *Iriſh*, when firſt taken ſick, immediately to unſheet their Bed, and roll themſelves in the Blankets. And ſome declare themſelves to have with great Advantage to their Health, wore flannel Waſtcoats and Drawers next their Skins.

28. It muſt alſo be obſerved that the *Air*, whereto the Body is accuſtomed, conſumes leſs than new, or a frequent change of Air; whence poor People that never remove from their own Roof, are generally long lived: in other Reſpects, we judge a change of Air to be uſeful, eſpecially to thoſe of briſk Spirits; but a Moderation herein may prove beſt on all accounts. The way wou'd be to change the place of aboad, and at ſtated times remove to proper Seats, ſuited to the four Seaſons of the Year; whereby the Body might have neither too much fatigue in Travelling, nor too much reſt at Home. And this for the Operation of excluding the Air, to avoid its predatory or conſuming Force. *Accuſtom'd Air leſs predatory.*

III.

The Hiſtory of the Operation upon the Blood, and the proper Heat for Sanguification.

1. *THE preſent and the following Operation are the Converſe of the two foregoing; and anſwer to them as Paſſives to Actives: for as thoſe prevent the Spirits and Air from being too predatory in their Actions; ſo theſe ſecure the Blood and Juices of the Body, and keep them indiſpoſed to be prey'd upon. But as the Blood is the Fountain that ſupplies the Juices, waters the Parts, and is the Matter prepared for compoſing them, we aſſign the firſt place to the Operation upon the Blood; with regard whereto we ſhall lay down three very effectual Directions.*

The Blood to be cooled.

2. And *firſt*, no doubt if the Blood be brought to a cooler Temper, it will become leſs diſſipable; but as Refrigerants taken by the Mouth, ill comport with many other Intentions, 'tis moſt adviſable to find out others, not ſubject to ſuch Inconveniences: and there are two of them.

By the uſe of Glyſters.

3. The one is, the uſe of Glyſters, in no reſpect purging or abſterſive, but only cooling and ſomewhat opening; to be injected principally in Youth: and thoſe are beſt approved which conſiſt of the juice of Lettuce, Purſlane, Liverwort, the greater Houſeleek, and the Mucilage of Flea-wort-ſeed; with the addition of ſome moderately aperient Decoction, and the admixture of a little Camphire: but in declining Age, let the Houſeleek and the Purſlane be omitted; and the Juices of Borage, Endive or the like be ſubſtituted for them. Theſe Glyſters ſhou'd be retain'd as long as poſſible, or for an Hour or more.

Warm Bathing.

4. The *ſecond* is to uſe, eſpecially in the Summer, Baths of ſweet and ſcarce lukewarm Water, without any emollient Ingredients; ſuch as Mallows, the Herb Mercury, Milk, *&c.* but rather a moderate proportion of new Whey, and Roſes.

Caſing the Body before Bathing.

5. But what we take for the Capital thing of all in this Intention, tho never mention'd till now, is, before Bathing, to anoint the Body with Oil, properly thickned like a Paint; that the coolneſs of the Water may be received, yet the Water itſelf kept off; tho without cloſing the Pores of the Body too much: for where external Cold ſhuts up the Body ſtrongly, 'tis ſo far from procuring coolneſs, as rather to prevent it, and excite Heat.

The uſe of Bladders filled with cooling Liquors.

6. What bears ſome Analogy to this, is, the uſe of Bladders fill'd with refrigerating Decoctions and Juices, and applied to the lower Region of the Body, *viz.* the whole Abdomen; thus making a kind of Bath, where the Subſtance of the Liquor is excluded, and its coldneſs principally, or alone received.

7. The

7. The *third* Direction regards not the quality, but the ſubſtance of the Blood; with deſign to render it leſs diſſipable, cloſer of Texture, and of ſuch a Diſpoſition, that the heat of the Spirit may the leſs affect it. *Condenſing the Blood.*

8. And for the uſe of Gold, either in Leaf, or Filings; the Powder of Pearl, Coral, Gems and the like, we have no farther opinion thereof, than as they may poſſibly anſwer the preſent Intention: and ſurely ſince not only the *Arabians*, but alſo the *Greeks* and the Moderns have aſcribed ſuch great Virtues to theſe Medicines, there may ſeem to be ſomewhat in them, which ſo many Perſons declare they have experienced. To drop, therefore, all fanciful Notions about them, we judge, that if there cou'd be ſome ſuch thing convey'd into the whole Maſs of Blood, and intimately mix'd therewith in the ſmalleſt Particles, whilſt the Spirits and Heat might have little or no effect upon this Matter; it wou'd prevent, not only Putrefaction, but Dryneſs, and prove exceedingly efficacious in prolonging Life. But this Affair requires ſeveral Cautions; as (1.) That the Subſtance be ground extremely fine; (2.) That it be free from all Malignity, leſt coming into the Veins, it ſhou'd do Miſchief; (3.) That it be never taken at Meals, nor ſo as to lodge long by the way, for fear of producing dangerous Obſtructions about the Meſentery; and (4.) That it be uſed but ſeldom, to prevent its clodding in the Veins. And therefore let it be taken in the Morning faſting, in a Glaſs of white Wine, mix'd with a little Oil of Almonds; and uſing ſome proper bodily Exerciſe upon it. *The introducing a fix'd and durable Subſtance into the Blood.* *The Cautions it requires.*

9. The Simples beſt conducive to this Operation may be reduced to three, *viz.* Gold, Pearl, and Coral; for all the other Metals, except Gold, have ſome malignant quality in their volatile part; nor can they be ſo exquiſitely ground as Leaf-gold. And for all the tranſparent Gems, they are but a kind of Glaſs; and therefore to be rejected for fear of wounding and tearing the finer Veſſels. *The Simples beſt ſuited to the Intention.*

10. But, in our Judgment, it wou'd be ſafer, and more effectual to uſe Woods by way of Infuſion or Decoction; as theſe may be ſufficiently able to give ſtrength and durability to the Blood, without the danger of cauſing Obſtructions; eſpecially as they may be taken along with the Diet, and thence be the eaſier received into the Veins, and not thrown off with the Fæces. *Woods prefer'd.*

11. The Woods proper for this purpoſe are Saunders, Oak, and the Vine; for we reject the hotter kinds, and ſuch as are any way reſinous. We might alſo add the dry and woody Stalks of Roſemary; this being a Shrub as durable as many Trees: and again the dry and woody Stalks of Ivy; to be uſed in ſuch proportion as not to prove ungrateful to the Taſte. *The ſorts to be choſe.*

12. Let theſe Woods be taken either boil'd in Broths, or ſteep'd in new Wine or Beer, before the Liquor grows fine. When uſed in Broths, let them be long infuſed before boiling, that the firmer part of the Wood, and not only that which ſticks but looſely in it, may be drawn out. And ſo much for the operation upon the Blood. *How to be uſed.*

IV.

IV.

The Hiſtory of the Operation upon the Juices of the Body.

Two kinds of durable Subſtances.

1. WE before obſerved, in our Enquiry into inanimate Bodies °, that there are two kinds of Subſtances which conſume with difficulty; *viz.* hard and fat ones; as appears in Metals and Stones; Oil and Wax.

The Intention what.

2. The *Intention*, therefore, muſt be to render the Juices of the Body *hardiſh* and *unctuous*.

Hardneſs how procurable to the Juices.

3. Hardneſs is procurable to them three ways; *viz.* (1.) By aliment of a firm Nature; (2.) By Cold, condenſing the Skin and Fleſh; and (3.) By Exerciſe, binding up and working the Juices together, or preventing them from growing ſoft and frothy.

The aliments to be choſe.

4. The Aliment ſhou'd be of the moſt ſubſtantial or undiſſipable kind; as Beef, Pork, Veniſon, Goat, Kid, Swan, Gooſe, and Ring-dove; eſpecially when moderately ſalted: again, ſalt and dry'd Fiſh, old Cheeſe, *&c.*

The Bread.

5. As to Bread; that of Oats, or with a little mixture of Peaſe, and that of Rye or Barley is more ſolid than that of Wheat; and of Wheat Bread, that is the more ſolid which has ſomewhat more of the Bran.

6. The Inhabitants of the *Orcades*, who feed upon ſalt Fiſh, and generally all Fiſh-eaters, are long lived.

7. The Monks and Hermites, who uſed a ſparing and dry Diet, were alſo generally long lived.

The uſe of Water for Drink.

8. A free uſe of clear Water for Drink, renders the Juices of the Body leſs ſpumy; and becauſe of the dulneſs of its Spirit, which doubtleſs in Water is not very penetrating, we judge it of uſe to diſſolve a little *Nitre* therein. And ſo much for the *firmneſs of the aliment.*

Living in the cold Air.

9. (2.) As for condenſing the Skin and Fleſh by Cold; we find ſuch Perſons are generally longer lived, who live in the open Air, than thoſe that live under Cover; and the Inhabitants of cold Countries longer lived than thoſe of hot ones.

Hot Lying.

10. Too much Covering upon the Bed, and too much Clothing, ſoften and diſſolve the Body.

Cold-Bathing.

11. Cold-Bathing is ſerviceable to prolong Life; but Warm-Bathing is prejudicial: and for Bathing in aſtringent mineral Springs, we have ſpoke of it above P.

Exerciſe.

12. (3.) With regard to Exerciſe; an unactive Life manifeſtly renders the Fleſh ſoft and diſſipable; but robuſt Exerciſe, if without too much Sweat and Laſſitude, hard and compact. Exerciſe alſo in cold Water, as that of ſwimming is very advantageous; and, in general, Exerciſe in the open Air, is better than under Cover.

13. But

° *See* Sect. I.

P Pag. 380. §. 9.

13. As for Frictions, tho theſe are a Species of Exerciſe, yet as they rather call forth than indurate the Aliment, we ſhall not ſpeak to them here, but hereafter. *Frictions.*

14. We come next to the Unctuouſneſs or Roſcidity of the Juices; which is a more perfect and powerful Intention than Induration; as having no inconvenience or miſchievous Effect: for all thoſe Things which tend to harden the Juices, at the ſame time that they prevent the waſting of the Aliment, alſo prevent its repair; and thence are both conducive to, and preventive of Long-Life; whilſt that which regards the Roſcidity of the Juices, proves advantageous in all Reſpects; as rendering at once the Aliment leſs diſſipable, and more reparable. *The procuring of balſamick Juices.*

15. By ſaying that the Juices ſhou'd be roſcid or unctuous, we mean not this of any manifeſt Fat; but only that a dewy, balmy, or, to uſe the vulgar Expreſſion, a radical Moiſture, ſhou'd be every way diffuſed thro' the Habit or Subſtance of the Body. *Roſcidity of the Juices what.*

16. Nor again, let any one imagine that Oil, or fat Meats, or Marrow, beget theſe Juices, and ſo anſwer the preſent Intention; for whatever is once perfected, never goes its Courſe over again: but the Aliment ought to be ſuch as, after Digeſtion and Maturation, at length produces a balmineſs in the Juices. *Roſcidity not owing to Fat.*

17. Nor muſt it be imagined, that tho ſimple Oil or Fat collected together, be of itſelf hard to diſſipate; yet it aſſumes another Nature in mixture: for as Oil alone, waſtes much ſlower than Water alone, ſo does it alſo hang longer in Paper or Cloth, and dries ſlower; as was obſerved above. *Fat not diſſipable even in mixture.*

18. For ſpreading theſe roſcid Juices thro' the Body, roaſted or baked Meats are better diſpoſed than boil'd; and all Preparations of Meat with Water are leſs proper: thus we ſee that Oil is yielded more copiouſly by dry Bodies than by moiſt ones. *Roaſted Meats recommended.*

19. In general, the free uſe of ſweet Things conduces to procure this Roſcidity of the Juices; ſuch as Sugar, Honey, ſweet Almonds, Pine-apples, Piſtachios, Dates, Raiſins, Currans, Figs, *&c.* As on the contrary, all acid, over ſaline, and too acrimonious Things, are preventive thereof. *Sweet Things.*

20. Nor let us be thought to favour the *Manichees*, and their Diet, if we direct a frequent uſe of Seeds, Nuts, and Roots, in Meats or Sauces; ſince all Bread, which is the capital Food, is either made of Seeds or Roots.

21. But above all, the quality of Drinks is what moſt conduces to diffuſe roſcid Juices thro' the Body; as being the Vehicle of the Food: and therefore let the Drink turn upon ſuch Liquors as are ſubtile, but without Acrimony or Acidity; *viz.* Wines which have loſt their pungency; or, as the old Woman in *Plautus* expreſſes it, are grown *Toothleſs with Age* [P]. And the ſame is to be underſtood of Malt-Liquors. *Drinks.* *Mellow Wines.*

[P] Vina vetuſtate edentula.

Mead.

22. We conceive that *Mead* would be a proper Liquor, if made ſtrong and kept till it was old; but ſince all Honey has ſome acid or ſharp Parts, as appears from the corroſive Water which Chemiſts draw from it that even diſſolves Metals, it were better to make a like Drink of Sugar; not by a ſlight Infuſion, but by a thorough Incorporation; in the ſame manner as Honey is incorporated in *Mead*: and this ſhould be kept for a Year, or ſix Months, before 'tis uſed; whereby the Water employ'd in the Compoſition, may both loſe its Crudity, and the Sugar acquire a Subtilty of Parts [q].

The Acrimony of Liquors corrected.

23. Age, in fermented Liquors, has the property of procuring Subtilty in all the Parts, and Acrimony in the Spirit; the former of which is beneficial, but the latter prejudicial: therefore, to remedy this undue Mixture, let a proper Portion of well-boil'd Veniſon, or Pork, be put into the Caſk, before the Liquor is fallen fine, or whilſt it continues new; that the Spirit of the Liquor may have ſomewhat to feed and prey upon; and thence depoſite its Acrimony [r].

The Drink of Grain improved.

24. In like manner, a Drink brew'd, not entirely of Grain; as malted Barley, Wheat, Oats, Peaſe, *&c.* but with the Addition of about a third part of Roots, or fat Pulps; as Potatoes, Artichoak-bottoms, Burdock-roots, *&c.* we conceive would be more conducive to long Life, than a Drink prepared entirely of Grain.

Sauces, Pickles, &c.

25. Again, ſuch things as abound with very fine Parts, yet, without all Acrimony or Pungency, may be employ'd in the way of Sauce, Pickle, or Sallad: and this kind of Property we find in ſome few Flowers; as thoſe of Ivy; which being pickled in Vinegar, are pleaſant to the Taſte; thoſe of Marigold, and thoſe of Betony. And ſo much for the Operation upon the Juices of the Body.

V.

The Hiſtory of the Operation of the Viſcera; *for protruding the Aliment.*

The Four grand Viſcera to be aſſiſted.

1. THE Writings, Preſcriptions, and Directions of Phyſicians, may ſhew what things aſſiſt the four principal Viſcera; (*viz.* the Stomach, the Liver, the Heart, the Brain; which are the Seats of Concoction) in the due performing of their Functions; whereby the Aliment is diſtributed into all the Parts, the Spirits ſent out, and thence the repair of the whole Body ſecured.

Leſs Notice here taken of the ſecondary Viſcera.

2. We here ſpeak not of the Spleen, the Gall, the Kidneys, the Meſentery, the Inteſtines, and the Lungs; becauſe theſe are Parts ſubſervient to the principal ones: tho in a Diſcourſe of Health and Diſeaſes, they might ſometimes be of capital Conſideration; as each of them has its particular Diſtempers, which, unleſs cured, affect alſo the principal Viſcera. But with regard to the prolongation of Life, the repair by Alimentation, and retarding

[q] See the Article SUGAR, in the *Sylva Sylvarum.*

[r] See the Articles CLARIFICATION, DRINKS, *&c.* in the *Sylva Sylvarum.*

ing the Waſte brought on by Old Age; if the Concoctions and theſe principal *Viſcera* are well ſecured, the reſt, in great meaſure, proceeds ſucceſsfully.

A Regimen to be formed for every Conſtitution.

3. Every one muſt, for himſelf, collect ſuch Particulars from the Writings of the Phyſicians that treat of comforting and preſerving the four principal *Viſcera*, as the Nature and Conſtitution of his Body requires; and apply them in his Diet and Regimen of Life: for the preſervation of Health generally requires only temporary Remedies; but the prolongation of Life is to be endeavoured by a thorough Regimen, and a conſtant courſe of aſſiſting Remedies: a few of the beſt whereof, ſelected with Choice, we ſhall here propoſe.

The Stomach, how provided for.

4. The *Stomach*, which provides for all the other Parts, and whoſe Strength is fundamental to all the other Concoctions, ſhould be ſo defended and ſecured as to remain moderately warm, conſtringed, clear, and unoppreſſed by nauſeating Humours; yet never entirely empty; as being rather nouriſhed by itſelf than by the Veins: and laſtly, in good Appetite; becauſe Appetite promotes Digeſtion.

Hot Liquors recommended.

5. It ſeems ſtrange, that the Practice of drinking Liquors hot, which prevailed among the Antients, ſhould be grown into diſuſe. I remember a very eminent Phyſician that uſed, at Dinner and Supper, greedily to ſwallow down his Broth very hot; and preſently after to wiſh it up again, ſaying, *He did not want the Broth; but only the Heat.* And indeed I conceive it uſeful, to take the firſt Glaſs of Liquor, whatever it be, always hot at Supper.

Gold quenched in Wine.

6. We likewiſe judge ſuch Wine proper at Meals, wherein Gold has been quenched; not as believing the Gold communicates any Virtue to the Wine; but, as knowing that all Metals quenched in any Liquor, give it a powerful Aſtringency: and we make choice of Gold, becauſe it leaves no other metallic Impreſſion, beſides the deſired Aſtringency, behind.

Bread ſteeped in Wine.

7. Towards the middle of the Meal, we judge, that Bread dipped in Wine, is better than Wine itſelf; eſpecially if the Wine 'tis dipped in be firſt impregnated with Roſemary and Citron-peel; and alſo ſugar'd, to make it paſs the ſlower.

Quinces.

8. The Uſe of Quinces is, by Experience, found to ſtrengthen the Stomach; but, in our Judgment, the clarified Juice made into a Marmalade, or Syrup, with Sugar, is preferable to the Fleſh, or Pulp; as it thus proves leſs oppreſſive to the Stomach: and the Marmalade eat by itſelf, after Meals, or along with Vinegar before them, is excellent.

The beſt Simples for the Stomach.

9. The Simples beſt ſuited to the Stomach are *Roſemary*, *Ellicampane*, *Wormwood*, *Sage*, and *Mint*.

Pills.

10. We approve of Pills compoſed of *Aloes*, *Maſtich*, and *Saffron*, taken before Dinner, eſpecially in the Winter; provided the Aloes be not only ſeveral times waſhed in the Juice of Roſes, but alſo in Vinegar, wherein Gum Traganth is diſſolved; and afterwards ſteeped, for ſome Hours, in freſh drawn Oil of ſweet Almonds, before 'tis made up into the Maſs [r].

Medicated Drinks.

11. Wormwood-Ale, or Wine, with a ſmall addition of Ellicampane and yellow Saunders, is properly uſed at Intervals; tho beſt in the Winter.

[r] See the Article MEDICINE, in the *Sylva Sylvarum*.

Medicated Wines. 12. But in the Summer, a Glaſs of white Wine diluted with Strawberry-water; the Wine having firſt ſtood upon fine Powder of Pearls, Craw-fiſh-ſhells, and (tho this may ſeem ſtrange) a little Chalk; admirably ſtrengthens and refreſhes the Stomach.

Morning-draughts. 13. But in general, all Morning-draughts of cooling Liquors, whether Juices, Decoctions, Whey, *&c.* are to be avoided; and nothing that is purely cold taken upon an empty Stomach. Such things are better uſed, if Occaſion be, five Hours after Dinner; or an Hour after a light Breakfaſt.

Faſting. 14. Often faſting is prejudicial to long Life; and all Thirſt muſt be avoided: the Stomach being kept ſufficiently clean, but continually moiſt.

Unguents. 15. A little *Mithridate* being diſſolved in freſh Oil-Olive, and rubbed upon the Spine, oppoſite to the Mouth of the Stomach, ſtrangely cheriſhes and refreſhes the Stomach.

Quilts. 16. A little Bag filled, with fine teazed Wooll, or ſcarlet Flox, and ſteeped in rough red Wine, impregnated with Myrtle, Citron-peel, and a little Saffron, may be conſtantly wore upon the Stomach. But enough of Remedies for comforting the Stomach; ſince many of thoſe which anſwer the other *Intentions*, alſo conſpire to anſwer this.

The Liver, how to be regarded. 17. As to the *Liver*; if it be preſerved from Dryneſs and Obſtruction, it requires nothing more; for that Relaxation of it which produces Aquoſities, is plainly a Diſeaſe: but the coming on of Old Age, alſo cauſes the other two. And this *Intention* is chiefly anſwered by the Remedies above ſet down, under the Operation upon the Blood: but we will here add a few more to them, ſelected with choice.

Pomgranate-Wine. 18. Let a principal Uſe be made of the Wine of ſweet Pomgranates, or, if that cannot be procured, of their Juice freſh expreſs'd: to be taken in the Morning with a little Sugar, a Bit of freſh Citron-peel, and three or four whole Cloves, put into the Glaſs wherein the Juice is ſqueezed. And let this be continued from *February* to the end of *April*.

Creſſes. 19. Before all other Herbs, let young Creſſes be uſed; either in the way of Sallad, in Broths, or in Drinks; and next to this Scurvy-graſs.

Aloes. 20. Aloes, in what manner ſo ever waſhed, or corrected, is prejudicial to the Liver; and therefore never to be uſed common: but Rhubarb is ſovereign to the Liver, if uſed with three Cautions; *viz.* (1.) If taken a little before Meals; to prevent its drying too much, or leaving a Stypticity behind: (2.) If it be ſteep'd for an Hour or two in freſh Oil of Almonds, along with Roſe-water, before it be otherwiſe infuſed, or given in Subſtance: And, (3.) if taken alternately, one while ſimple, another while with Tartar, or a little Bay-ſalt; to prevent its carrying off only the finer Parts, and leaving the Maſs of Humours more ſtubborn than before.

Chalybeates. 21. We judge it proper to take a Doſe of Chalybeate Wine, or Decoction, three or four times a Year; to diſſolve the more ſtubborn Obſtructions; provided it be each time preceded by two or three Spoonfuls of new drawn Oil of ſweet Almonds, and followed by due Motion of the Body; eſpecially of the Arms and Belly.

22. Sweet

22. Sweet Liquors, made with a Mixture of ſome fat Subſtance, have a great and capital Efficacy to prevent Dryneſs, Parchedneſs, and Saltneſs of the Liver; and preſerve it in a youthful State; eſpecially if they are well incorporated by Age. Thus, in particular, Wines and Drinks made of new Raiſins, Jujebs, Figs, Dates, Parſnips, Piſtachios, the bulbous Roots, as Potatoes, *&c.* ſometimes with a Mixture of Liquiriſh; and again, Drinks made with Maiz, or *Indian* Corn, are of great ſervice. And the *Intention* of preſerving the Liver in a certain ſoft and balmy State, is of much greater Efficacy than that which regards the opening of it; which rather tends to Health than the prolongation of Life: only ſuch Obſtructions as cauſe Parchedneſs of the Liver, are as deſtructive as other kinds of Dryneſs. *Sweet and unctuous Liquors.*

23. The Roots of Succory, Spinage, and Beet, ſeparated from their Pith, and boiled tender in Water, with a third part of white Wine, are ſerviceably eat along with Oil and Vinegar, in the way of Sauce at Meals; ſo likewiſe are Aſparagus, Artichoak-bottoms, and Burdock-roots, properly boiled, and ſerved up in the ſame manner: and again, in the Spring-time, Pottage made with Vine-buds, and the green Blades of Wheat. And ſo much for preſerving the Liver. *Sauce.*

24. The *Heart* receives the greateſt Relief and Prejudice, (1.) From the Air we breathe; (2.) From Odours and Vapours; and, (3.) From the Paſſions of the Mind. And, in this reſpect, many of the Particulars above noted of the Spirits, may be applied here. But as for the indigeſted heap of Cordials, to be found among the Writers on Medicine, they are of little ſervice in this *Intention*; only ſuch as have an antidotal Virtue may be uſed, with Judgment and Diſcretion, for ſtrengthening the powers of the Heart; eſpecially ſuch as do not ſo much oppoſe the peculiar Nature of Poiſons, as fortify and preſerve the Heart and Spirits againſt them. And for particular Cordials, the *Table* of them, above drawn up, may be conſulted [f]. *The Heart, how to be regarded.*

25. A wholeſome Air for Habitation, is better diſcovered by Experience than by Signs: but we judge that of open Plains, or champaign Countries, to be the beſt; where the Soil is dry, not parched or ſandy, but ſpontaneouſly grows wild Thyme, and wild Marjoram; with up and down ſome Tufts or Sprinklings of Calamint; and which is not otherwiſe bare, but interſperſed with Trees for Shade; and where alſo the Dog-roſe ſmells ſomewhat aromatic. As for *Rivers*, we conceive them rather prejudicial; unleſs very ſmall, clear, and gravelly-bottom'd. *Wholeſome Air.*

26. 'Tis certain that the Morning Air is more vital and refreſhing than that of the Evening; tho the latter be coveted more thro' Delicacy. And we judge the Air agitated with Breezes, to be more healthy than that which is ſerene and ſtill. The weſtern Breezes ſeem wholeſomeſt in the Morning; but in the Afternoon the northern. *The Morning Air.*

27. *Odours* are very effectual in reviving the Heart. But a good Odour is no property of a good Air; for ſome Airs are found to be perfectly peſtilential, tho of a leſs diſagreeable Scent than others more innocent; *Odours.*

[f] See *Sect.* VII.

nocent; in like manner, converſely, there are wholeſome Airs, and very agreeable to the Spirits, yet either abſolutely inodorous, or leſs fragrant and grateful to the Senſe. And thoſe who live in a good Air, ſhould only make uſe of Odours at certain Intervals; becauſe a continued Odour, tho ever ſo excellent, proves ſomewhat oppreſſive to the Spirits.

Thoſe of growing Vegetables.

28. And for this purpoſe we recommend, before all others, the Odours of Plants and Vegetables, uncropt and growing, to be received in the open Air; as from blooming Violets, Pinks, and July-flowers; Bean-flowers, Lime-Tree-bloſſoms, Honey-ſuckles, yellow Wall-flower, Muſk-roſes, which yield their Smell more copiouſly on the Buſh than other Roſes; dying Strawberry-beds, Sweet-briar, Calamint, Lavender in flower: and, in hot Countries, Oranges, Citrons, Myrtle, and Bays. And therefore to walk, or ſit ſometimes in the Atmoſpheres of theſe Vegetables, will be of Uſe.

Cooling Odours.

29. For recreating the Heart, we prefer cooling Odours to ſuch as are heating; and therefore recommend as excellent, and to be uſed in the Morning, or during the Noonday-heat, a certain Perfume or Vapour, made by throwing a Mixture of equal Parts of Vinegar, Roſe-water, and good Wine, upon a hot Iron Plate. And the ſame Intention might be anſwered by pouring fragant Wine into a Hole made in good freſh Earth, and ſtirring the moiſten'd Mould about with a Spade. 'Tis likewiſe excellent, now and then, to ſmell at, or ſnuff up the Noſtrils, Orange-flower-water, mix'd with a moderate proportion of Roſe-water, and fragrant Wine.

Maſticatories.

30. *Maſticatories* held almoſt continually in the Mouth, compoſed of ſuch things as cheriſh the Spirits, are exceeding uſeful. And to ſupply the Want of the famous *Indian Betel*, little Troches may be made of Orrice-root, *Lignum Aloes*, *Lignum Rhodium*, Roſes, Muſk, and Ambergreaſe; the Maſs being beat up with Roſe-water, and a little *Indian* Balſam.

Vapours.

31. The *Vapours* ariſing from things taken internally, for ſtrengthening and fortifying the Heart, ſhould be *benign*, *clear*, and *cooling*; for Heat in Vapours is bad: and Wine itſelf, tho thought to have only a heating Vapour, is not without ſome opiate Virtue. By *clear Vapours* we underſtand, ſuch as have more of real or aqueous Vapour than of fume or exhalation; without at all participating of ſmokineſs, ſootineſs, or greaſineſs; but being purely moiſt and uniform.

Cordials for Diet.

32. From an unwieldy heap of *Cordials* we may ſelect a few, fit to be made a part of Diet: and what may ſupply the place of all the reſt, are, for the purpoſe of Warming; Ambergreaſe, Saffron, and Kermes-berries; and for cooling, the Roots of Bugloſs, and Borage, as alſo Citrons, Lemmons, and Apples.

Gold and Bezoar.

33. We have, above, ſpoke of *Gold* and *Pearls*, which taken in the manner there preſcribed, may, beſides their Action in the finer Veſſels, have alſo ſome Effect upon the *Viſcera* in their Paſſage; and cool without any noxious Quality. But for *Bezoar*, tho, by reaſon of the numerous Inſtances of its Virtues, we cannot wholly reject it; yet doubtleſs its Preparations ſhould be ſuch as may make it eaſily impart its Virtue to the Spirits:

ſo

ſo that we cannot approve of taking it in Broths, Syrups, Simple-waters, or the like; but rather in Wine, Cinnamon-water, or the like ſpirituous and diſtilled Liquors, tho not made hot and ſtrong.

34. We have already ſpoke to the Paſſions of the Mind, and have only here to add, that all great, laſting, noble, or heroical Deſires, ſtrengthen and enlarge the Powers of the Heart. *Paſſions.*

35. With regard to the *Brain*, the Seat and Office of the animal Spirits, what we have above delivered of *Opium*, of *Nitre*, and their Subſtitutes, and again, of procuring quiet Sleep, have ſome right to this place alſo. And as 'tis certain that the *Brain* is under the Influence of the Stomach; what is before ſaid of defending and preſerving the Stomach, may likewiſe be underſtood of the Brain by conſent. We ſhall, however, propoſe a few Remedies for the Brain in its own Particular; three of them external, and one internal. *The Brain, how to be regarded.*

36. And *firſt*, we recommend the Practice of Bathing the Feet, at leaſt once a Week; the Bath being prepared of a Decoction of Sage, Camomile, Fennel, ſweet Marjoram, Coſtmary, the green Leaves of Angelica, and Bay-ſalt. *Bathing the Feet.*

37. We likewiſe recommend a Suffumigation, or Fume, to be uſed every Morning; the Ingredients thereof being dried Roſemary, dried Bay-twigs, and *Lignum Aloes*; omitting the ſweet Gums, which oppreſs the Head. *Fumes.*

38. Great care muſt be taken of applying hot things externally to the Head; as Spices, or even Nutmeg itſelf: ſuch hot things are only fit for the Soles of the Feet, and ſhould be no where elſe applied. Yet we recommend a gentle anointing of the Head with Oil, made by the Infuſion of Roſes and Myrtle; with the Addition of a little Salt and Saffron. *Hot things to be avoided.*

39. Conſidering what is above delivered of Opiates, *Nitre*, and the like, which greatly condenſe the Spirits; we judge it proper once in a Fortnight, to take three or four Grains of *Caſtor*, with a little *Angelica* Seed, and *Calamus Aromaticus*, in the Morning; for theſe Ingredients ſtrengthen the Brain, and excite a Vivacity and Vigour in that denſity of Spirits, which is ſo neceſſary to long Life. *Caſtor.*

40. In theſe Methods of ſupporting the four principal *Viſcera*, we have offered ſuch things as are well adapted, culled out by a deliberate Choice, and capable of being brought into Diet and Regimen, with ſafety and convenience: for multiplicity of Medicines is the Child of Ignorance. Nor is it ſo certain, that many Diſhes cauſe many Diſeaſes; as that many Medicines perform few Cures. And ſo much for operating upon the principal *Viſcera*, with regard to protruding the Aliment.

VI.

The Hiſtory of the Operation upon the external Parts; *for attracting the Aliment.*

The attractive Power of the external Parts to be excited.

1. ALtho it be the capital thing towards a perfect Alimentation of the Body, to have Concoction well performed in the internal Parts; yet the external alſo muſt contribute their Action; that as the inward Faculty propels and ſends out the Nutriment; ſo the Faculty of the outward Parts may attract and lay hold of it: and the weaker the digeſtive Faculty proves, the more Occaſion it has for the concurring Aſſiſtance of the attractive one.

This Attraction, how cauſed.

2. A powerful Attraction of the external Parts, is principally cauſed by the Motion of the Body; whereby the Parts being heated and cheriſhed, eagerly invite, and attract the Aliment to them.

The Caution it requires.

3. But great Care muſt be had, that the ſame Motion and Heat which call forth the new Juices to the Parts, do not at the ſame time too much rob thoſe Parts of the Juices they were before ſupplied with.

Frictions.

4. *Frictions* highly conduce to anſwer this *Intention*, being uſed particularly in the Morning; but this Operation ſhould always be immediately ſucceeded by a ſlight Motion of the Body; leſt otherwiſe the Attrition ſhould exhauſt and dry up the external Parts, by making them perſpire too much.

Exerciſe.

5. What approaches neareſt to this is *Exerciſe*, by which the Parts mutually rub and chafe each other; but it ought to be moderate, not too quick, nor above the Strength, or productive of Laſſitude. And here, as well as in the caſe of Frictions, care muſt be had that the Body perſpire not too much: and therefore Exerciſe is better in the open Air than under Cover; and better in Winter than in Summer. But Exerciſe ſhould not only, as well as Frictions, be ſucceeded, but alſo, when vehement, preceded by Unction; in the manner of the antient Wreſtlers.

To prevent its waſting the Spirits.

6. That *Exerciſe* may not too much conſume the Spirits, or diſſolve the Juices, 'tis beſt to be uſed upon a Stomach not quite empty: and therefore, that it may not be practiſed upon a full Stomach, which is very prejudicial to Health; nor Faſting, which is very prejudicial to long Life; a proper kind of Breakfaſt ſhould be uſed, conſiſting both of Meat and Drink; tho in a very moderate and ſparing Quantity.

Exerciſes for ſpreading the Juices thro' the Body.

7. *Exerciſes* for diſtributing the Juices thro' the Body, ſhould affect all the Limbs equally; and not ſo as to move the Legs, and reſt the Arms, *&c.* but ſo as that every Part may have its Share of Motion: and it greatly conduces to long Life, that the Body be never long kept in the ſame Poſture; but to change it at leaſt every half Hour, except in Sleep.

The mortifying Regimen.

8. The things commonly uſed by way of Mortification, may be employ'd to prolong Life; for Hair-ſhirts, Scourging, and all Severities uſed to the external Parts, increaſe their attractive Power.

9. *Cardan* recommends the external Application of ſtinging Nettles, even in the caſe of Melancholy; but we have little certain Knowledge of their Efficacy: and ſuſpect the Practice of giving ſome venomous Quality; as the Nettles, by frequent Uſe, may breed Exulcerations and tettery Humours in the Skin. *Stinging Nettles.*

VII.

The Hiſtory of the Operation upon the Food; *ſo as to make it inſinuate into the Parts of the Body.*

1. THE vulgar Cenſure of Luxury, or variety in Diet, becomes the Mouth of a Reformer better than of a Phyſician: an uniform, ſparing Table may indeed ſomewhat prevent Interruptions in Health; but at the ſame time it is prejudicial to long Life; becauſe a various and different Mixture of Aliment is better and quicker admitted and received into the Blood and Juices, than ſuch as is ſimple and homogeneous. It has alſo a very great power to excite the Appetite; which is the Spur of Digeſtions. We therefore approve of a well furniſh'd Table; and a frequent change of Diſhes, according to the Seaſons of the Year, or otherwiſe [t]. *A free Table to be uſed.*

2. So likewiſe, that Notion of a Simplicity of Meats, without Sauce, is but flaſhy and idle; for well choſen Sauces are the wholeſomeſt preparations of Food, and contribute both to Health and long Life [v]. *Sauces to be allow'd.*

3. Care muſt be had to accompany Meats hard of Digeſtion, with ſtronger Liquors; and Sauces that penetrate and attenuate; but ſuch as digeſt eaſily, with thinner Drinks and richer Sauce. *The Sauce and Drink to be ſuited to the Food.*

4. To the Direction lately given, for taking the firſt Glaſs of Liquor warm at Supper, we here add, that by way of preparing the Stomach, a good ſpiced Glaſs of the Liquor any one is moſt accuſtom'd to, ſhould be taken warm, half an Hour before Meals. *Aromatic Liquors before Meals.*

5. A well regulated preparation, and dreſſing of Bread, Meats, and Drinks, directed with a View to the preſent *Intention*, is a thing of exceeding great moment; tho it appear mechanical, or to ſmell of the Kitchen and the Cellar; and infinitely more uſeful than all the pompous, fabled Virtues of Gold, Gems, and Bezoar. *The due dreſſing and preparing of Meats.*

6. To think of moiſtening the Juices of the Body by a moiſt preparation of the Food, is childiſh; this may ſomewhat allay the heats of Diſtempers, but is directly oppoſite to the Nature of a balmy Nutriment; and therefore, for the preſent *Intention*, the boiling of Meats is by no means comparable to roaſting, baking, and the like. *Dry dreſſing preferred.*

[t] Let due care be here taken to underſtand the Author juſtly; and the Grounds and Reaſons whereon he founds this Judgment.

[v] Many Phyſicians ſeem to have introduced a kind of monaſtic Diet into Medicine. Let the Enquiry be duly proſecuted on both ſides, before Judgment is paſſed.

Roaſting, how beſt performed.

7. Roaſting ſhould ever be performed quick, and with a briſk Fire; for Meats are pall'd, and loſe their nutrimental Parts, by delay, and continuing at a ſlow Fire.

Meat to be ſalted before dreſſing.

8. All the more ſolid Fleſh-meats in uſe ſhould not be dreſſed quite freſh; but a little ſalted; ſo as in great meaſure, or entirely, to prevent the Uſe of Salt at the Table: for Salt incorporated with the Food, is of more ſervice in diſtributing the Nutriment, than when uſed looſe.

New Way of preparing Meats.

9. There remain to be brought into Uſe, various proper Methods of macerating and ſteeping Fleſh in convenient Liquors, before 'tis dreſſed; like thoſe ſometimes practiſed in the pickling of certain Fiſh, and the preparing of Diſhes for the Oven [w].

Stamping or Bruiſing of Fleſh.

10. The beating, bruiſing, or ſtamping of Fleſh before 'tis dreſſed, is of ſingular ſervice. Every one acknowledges, that Game taken by Hawking, or by Hunting, eats the fineſt; unleſs where the Chaſe was too long continued: and certain Fiſh become much better Food by being whipt and beaten; as hard and auſtere Fruits become ſweet and ſoft by ſqueezing and preſſure. But the beſt Preparation of all would be, to bring into Uſe a Method of bruiſing and ſtamping the harder kinds of Fleſh before dreſſing.

Bread, how beſt prepared.

11. Bread moderately leavened, and very little ſalted, is the beſt; and ſhould be baked in a ſufficiently hot and quick Oven.

Drinks for long Life.

12. All that regards the preparation of Drinks for long Life, may be nearly included under a ſingle Precept. The Uſe of Water, as the only potable Liquor, may preſerve Life for ſome time; but, as we formerly obſerved, can never carry it to any great length. This needs no preparation. But for ſpirituous fermented Liquors, the capital and almoſt only Caution they require is, that their Parts be rendered exceeding ſubtile; and their Spirit exceeding mild and gentle. Age alone can hardly procure this Effect; for tho it renders the Parts ſomewhat more ſubtile, yet, at the ſame time, it renders the Spirits more acrimonious: and therefore we, before, gave Directions for ſteeping ſome fat Subſtance in the Caſk; to take off this acrimony of the Spirits. There is another Way of procuring the ſame Effect, without Infuſion or Mixture; *viz.* by keeping the Liquors in conſtant Agitation; as, either by carrying them to Sea, continuing them upon Carriages at Land; or ſuſpending ſmall Veſſels by Ropes, and ſwinging them daily, *&c.* for 'tis certain that ſuch local Motion attenuates their Parts; and works the Spirits ſo much into them, that they cannot afterwards turn tart, or biting [x].

The Food, how to be prepared in Old Age.

13. In extreme Old-Age, the Food ſhould be ſo prepared as to become a kind of half Chyle before 'tis uſed. But for Diſtillations of Meat, they are perfect Trifles; as the nutrimental and beſt part of them, does not at all riſe in Vapour.

Meat and Drink to be previouſly mixed.

14. To incorporate Meat and Drink together, before it comes into the Stomach, is advancing it a degree towards Chyle; and therefore, for Example,

[w] See the Author's *new Atlantis* ad finem. And his *Sylva Sylvarum*, under the Article FOODS.

[x] See the *Sylva Sylvarum*, under the Articles CLARIFICATION, MATURATION, *&c.*

Example, let Chickens, Partridges, Pheaſants, *&c.* be boiled in Water with a little Salt; then cleanſed, made dry, and ſtamp'd; and afterwards put into new Wine, or Beer, whilſt it is working, with the addition of a little Sugar.

15. Expreſſions alſo, and fine Choppings of Meats, well ſeaſoned, are proper for Men grown very old; the rather, becauſe they generally want Teeth to chew their Food; which is an extraordinary Method of preparing it. *Expreſſions and fine mincings of Meats.*

16. Three things may contribute to ſupply the defect of Teeth; *viz.* (1.) The Production of new ones; which ſeems extremely difficult, and not poſſible without an intimate and powerful Renovation of the whole Body. (2.) By hardening the Gums ſo, with the Uſe of proper Aſtringents, that they may in ſome meaſure perform the Office of Teeth; which ſeems not altogether impracticable. And, (3.) By preparing the Food in ſuch a manner as not to require chewing; which is a ready and eaſy Method. *The want of Teeth, how remedied.*

17. With regard to the Quantity of Meat and Drink; ſome Exceſs in both is now and then convenient, for waſhing or over-flowing all the Parts of the Body; and therefore immoderate eating and drinking, at certain times, ſhould not be abſolutely prohibited. *Some Exceſs in Meats and Drinks allowable.*

VIII.

An Explanation *of the Operation upon the laſt Act of aſſimilating the Food.*

THERE needs no more than a ſhort and ſimple Direction about the laſt Act of Aſſimilation; which is the thing intended by the three Operations *immediately preceding: as this Affair rather requires Explanation, than any variety of Rules.* **Tranſition.**

1. 'Tis certain, that all Bodies have ſome Appetite of aſſimilating, or turning into their own Subſtance, ſuch things as are next them. This is done copiouſly and briſkly by all ſubtile and pneumatical Bodies; as Flame, Air, and Spirits: and but very weakly by thoſe of a groſs, tangible Subſtance, which have their Appetite of Aſſimilation bound down, and reſtrained by a ſtronger Appetite of Reſt, and avoiding of Motion. *All Bodies have an Appetite of aſſimilating.*

2. 'Tis likewiſe certain that this Appetite of Aſſimilation, which we obſerve to be kept under, and render'd unactive, in groſs tangible Subſtances, is ſtill animated, ſomewhat releaſed, ſet free, excited, and at length actuated by Heat, or Spirit, coming in contact with them. And this is the only Reaſon why animate Bodies do, and inanimate Bodies do not aſſimilate. *This Appetite quickned by Heat.*

3. Again, 'tis certain that the harder the Conſiſtence of a Body is, the greater Heat it requires to excite the Act of Aſſimilation; but in Old Age it happens, very diſadvantageouſly, that all the Parts grow ſtubborn, and the Heat grows weak: and therefore this ſtubbornneſs of the Parts muſt be either mollified, or the Heat increaſed. But of malaxing the Parts we ſhall *Hard Bodies require more Heat to make them aſſimilate.*

preſently ſpeak, in particular; and have already propoſed many Expedients for preventing their Hardneſs. And for the other *Intention*, of increaſing Heat, we ſhall lay down a ſingle Rule, upon the ſtrength of the following AXIOM.

An AXIOM.

4. The Act of Aſſimilation, being excited by the Mediation of Heat, is an extremely ſubtile and intimate Motion, in the ſmall Particles of the Matters concerned: but ſuch Motions are in greateſt Vigour when all local Motion ceaſes; which might otherwiſe diſturb it. For the Motion of Separation into homogeneous Parts; as in Milk, where the Cream riſes, and the thinner Parts ſubſide; could never be effected if the Milk were kept, tho but in a gentle Agitation: nor will Water, or mixed Bodies, putrefy whilſt they are continued in perpetual local Motion.

The Rule it affords.

5. As, therefore, the Act of Aſſimilation is principally performed in Sleep and Reſt; eſpecially towards the Morning, after the Diſtribution has been made of the Aliment; we can think of no other Rule to anſwer this Intention, than to ſleep warm; and towards the Morning uſe ſuch a kind of Motion, or put on ſuch a prepared Linen Bed-gown, as may excite a moderate Heat; and upon this to ſleep again [y].

IX.

The Hiſtory of the Operation for mollifying the Parts; when they begin to dry; or for ſuppling and malaxing the Body.

Tranſition.

HAving already enquired into the internal Methods of ſuppling the Body, which proceed by many Windings and Turnings, in reſpect both of the Aliment and the Detention of the Spirits; and therefore neceſſarily operate but ſlow; we come next to enquire into the external and ſhorter ways of effecting the ſame Thing.

The Fable of Medea's *Cauldron.*

1. In the Fable of reſtoring *Pelias* to Youth, *Medea* preparing for the Operation, propoſes to cut the old Man's Body to pieces; and then to boil it with certain Simples in a Cauldron. But tho, literally, ſome kind of Coction may be requiſite in ſuch an Intention; ſurely the Body need not be cut in pieces for it. And yet ſome kind of cutting ſeems neceſſary, tho not with a Knife, but the Judgment; for as there is a great difference between the Conſiſtence of the *Viſcera* and other Parts, they cannot all be mollified the ſame way; but regard muſt be had to each of them reſpectively; beſides what belongs to the general Intention of ſuppling the whole Maſs of the Body: of which in the firſt place.

Bathing and Anointing, to ſupple the Body in general.

2. And if the Thing be poſſible; Bathing, Anointing, and the like, may conduce thereto. But we muſt not fondly imagine it performable, from

[y] The AXIOM above laid down, and the Rule deduced from it, may afford us a little Specimen of the Method wherein the Author here endeavours, and directs all other Enquiries to proceed.

from what we see happen in the steeping and macerating of inanimate Bodies; whereby they are rendred soft and tender, according to some Examples formerly produced: for this Operation is more facile upon inanimate Bodies, because they attract and suck in Fluids; but more difficult in animal Bodies, because Motion in them tends rather from the Center to the Circumference.

The common Baths of little Service.

3. And therefore, the common emollient Baths, in use, are of little Service, or rather opposite to this Intention; as they rather extract than insinuate; and rather loosen than confirm the Texture of the Body.

The Baths, and Unguents required for the purpose.

4. There are three Properties required in the Baths and Unctions design'd for this Operation, of duly and substantially supplying the Body. (1.) The first principal Property is, that they consist of such Things, as in their whole Substance are similar to the Body, and the human Flesh; and at the same time bland, and nourishing from without. (2.) That they have such Things mix'd with them, as by their subtilty of Parts may gain entrance; and so convey and spread the nutritive Virtue of the other Ingredients along with themselves: and, (3.) That they receive some small mixture of such Things as are constringent, or strengthening; not rough or austere, but balmy and cherishing; so that whilst the other two perform their Operation, all Exhalation from the Body may, as much as possible, be prevented; which might otherwise destroy the malaxing Virtue; and rather that, by constringing the Skin, and closing up the Pores, the Motion towards the internal Parts may be assisted and promoted.

Malaxing by means of Blood.

5. What approaches nearest to the substance of the human Body, is warm animal Blood; but that Conceit of *Ficinus* for restoring strength to old Men, by sucking Blood from the Arm of a young one, is strangely empty: for what nourishes internally, ought by no means to be consubstantial or perfectly homogeneous with the Body to be nourish'd; but of a somewhat lower and subordinate Class, that it may be converted: tho' for external Application, the more similar the Substance, the greater the Consent.

Baths of Blood.

6. It was antiently believed, that a Bath of Childrens Blood wou'd cure the Leprosy, and restore corrupted Flesh; insomuch that certain Kings have been envied by their Subjects for this Advantage. 'Tis related that *Heraclitus*, for a Dropsy, put himself into the warm Belly of an Ox, new kill'd: and the warm blood of Kittens has been used for the Erysipilas; and for renewing the Flesh and the Skin.

7. In Amputations, or in great Hemorrhages of a Limb, 'tis of use to thrust the bleeding part, into the bleeding Body of a Beast new kill'd; for this acts powerfully in stopping the Hemorrhage: the wounded part strongly attracting, and sucking to it, the warm Blood of the Creature, by consent; thus causing a regurgitation, a stoppage of the Flux[a].

Live Pigeons.

8. In dangerous and desperate Diseases, great use is made of live Pigeons, cut asunder, and applied, one after another, to the soles of the Feet; and this some-

[a] *Is this certain?*

ſometimes with wonderful Succeſs; the cauſe whereof is vulgarly aſſign'd to their attracting the malignity of the Diſtemper: but, in ſome meaſure, the Remedy has an effect upon the Head, and relieves the animal Spirits. But as all theſe kinds of bathing the Parts, or beſmearing them with Blood, appear to us filthy and diſagreeable; we ſhou'd look out for others, which are leſs loathſome, yet full as ſerviceable.

More agreeable Methods.

9. And next to recent Blood, the Things moſt ſimilar to the ſubſtance of the human Body, are of the nutrimental Kind; as the well fed Fleſh of Oxen; Swine, or Deer, Oyſters, Milk, Butter, Eggs, Wheat-Flower, and ſweet Wine, either ſugar'd or mix'd with Honey.

Salts to be added.

10. The Things to be mix'd along with others, for procuring Entrance and Admiſſion, are Salts, eſpecially Bay-ſalt: and theſe may be uſed inſtead of all the reſt. Wine alſo, that is full of Spirit, proves a good Introducer, and is an uſeful Vehicle.

Conſtringents.

11. The Conſtringents, of the Character above required, are Saffron, Maſtich, Myrrh, and Myrtle-berries; as being at once both unctuous and cheriſhing.

12. And out of theſe Ingredients, ſuch a Bath, in our Judgment, may be made, as we at preſent deſire. But Phyſicians, and Poſterity, may find ſtill better Expedients.

A Courſe of malaxing.

13. This Operation may be render'd much more effectual, if ſuch a Bath, which we conceive the principal Thing, be uſed; with the obſervance of theſe four Directions: (1.) That previous to bathing, the Body undergo Friction; and be afterwards anointed with Oil, made thick like Paint, that the moiſtening Heat and Virtue of the Bath may enter the Body, rather than the aqueous part of the Liquor. (2.) That the Bathing itſelf next enſue; and be continued for about two Hours. (3.) That after Bathing, the Body be coated over with a proper mixture of Maſtich, Myrrh, Gum Tragacanth, Saffron and Diapalma; to keep in, as much as poſſible, the perſpirable Matter, till the ſoftening Matter be by degrees turn'd into a more ſolid Subſtance: and that this be continued for twenty four Hours or more. (4.) And laſtly, That when this coating is taken off, the Body be anointed with Oil, whereto a little Salt and Saffron is added; the Bathing being repeated four Days afterwards, with the other parts of the Proceſs, as before; and the Courſe continued for a Month.

The Regimen during the Courſe.

14. During this Courſe of mollifying, we judge it uſeful, proper, and ſuitable to the Intention, that the Body be well fed; kept from the cold Air; and receive nothing in the way of Drink, without warming. But this Courſe is one of thoſe Things which we have not experienced; only ſet it down as what promiſes to anſwer the end: for having marked out the Road, we deliver the *traditory or illuminating Lamp* into other Hands [b].

The Application of live Bodies.

15. Nor ought the warm and cheriſhing Applications, of the Bodies of living Creatures, to be omitted. *Ficinus*, without intending a Jeſt, ſaid, that *David* might have had comfortable uſe of *Abiſhag*'s lying on his Boſom, had

[b] *See the* de Augment. Scientiar. Pag. 147.

had ſhe not come too late. He ſhou'd have added, that, after the manner of the *Perſian* Virgins, ſhe ought to have been perfum'd with Myrrh, and other Ingredients; not to pleaſe the more, but to increaſe the cheriſhing Virtue expected from the warmth of her Body.

16. *Barbaroſſa*, in extreme old Age, had, by the Advice of a *Jewiſh* Phyſician, young Boys continually applied to his Boſom; in order to warm, cheriſh and preſerve him: and ſome old Men accuſtom themſelves to apply young Puppies, which is a very hot kind of Creature, to their Stomach at Nights.

17. There goes a Report, not unſupported in many reſpects, that certain Perſons of monſtrous Noſes, have had the exuberant Parts and Bunches thereof pared down; and the Noſe trim'd to a moderate ſize; then making an Inciſion in the fleſhy part of the Arm, they have held the trim'd Noſe therein for a time, and thence procured it handſome. If this account be true, it affords a remarkable Inſtance of the conſent between Fleſh and Fleſh; eſpecially whilſt alive [c].

18. It wou'd be too tedious to enquire after, and preſcribe Rules for, mollifying all the principal Viſcera; as the Stomach, the Lungs, the Liver, the Heart, the Brain, the ſpinal Marrow, the Kidneys, the Gall-Bladder, the Inteſtines, Veins, Arteries, Nerves, Cartilages and Bones; as we are not now writing a Practice, but only ſetting down Indications for it. *The Enquiry for mollifying the Viſcera not proſecuted.*

X.

The Hiſtory of the Operation for diſcharging the old Juices, and ſupplying their Place with New; or the Buſineſs of Periodical Renovation.

THO what we ſhall deliver upon this Head, has in great meaſure been touch'd already; yet becauſe the Operation is capital, we will here treat the former matters again, with a more expreſs View to it. Tranſition.

1. 'Tis certain that draught-Oxen, worn down with Labour, being put into freſh Paſture, recover tender and young Fleſh; as we find by eating of it: whence it manifeſtly appears no difficult thing to procure tenderneſs to the Fleſh. And 'tis likewiſe probable, that if the Fleſh be thus ſeveral times made tender, the Effect may reach to the Bones, Membranes and the like. *Tender Fleſh procurable.*

2. 'Tis certain, that the uſual Courſes of Diet-Drinks, conſiſting principally of Guaiacum, as alſo of *Sarſa*, *China* and *Saſſafras*; eſpecially when long continued, and according to ſtrict Rules; firſt attenuate, and then conſume and waſte the whole Maſs of Juices; as plainly appears from hence, that they actually cure the Venereal Diſeaſe, even tho' grown ſo inveterate as to produce *Diet-drinks diſcharge the old and procure new Juices.*

[c] *See the Chirurgical Operations of* Taliacotius.

produce Nodes in the Bones; and corrupt and deprave the innermoſt Fluids of the Body: and again, becauſe the Perſons who are render'd extremely lean, pale, and almoſt cadaverous by ſuch kind of Diet-drinks, preſently afterwards grow fat, freſh coloured, and are manifeſtly renewed. And therefore we judge that ſuch a Courſe wou'd be extremely ſerviceable to the preſent Intention; being uſed once in two Years, in the decline of Age; and prove like caſting the Skin to the Snake; or procure a kind of Rejuveneſcency.

Advantage of familiar Purging.

3. And we are firmly perſuaded, that repeated and familiar Purging has a much greater power to prolong Life, than Exerciſe and Sweating. This muſt be the Caſe, if the former Poſition be true; that anointing the Body; blocking up the Pores from without; excluding the Air; and keeping the Spirits from exhaling greatly conduce to Longevity. For 'tis certain, that Sweating and Perſpiration, not only evaporate and conſume the ſuperfluous and excrementitious Humours and Vapours; but with them alſo the good Juices and Spirits, which are not ſo eaſily repaired: whereas the contrary happens in Purging, unleſs very immoderate; as this operates principally upon the excrementitious Humours. But the beſt Purges for the Intention, are thoſe taken before Meals; becauſe they thus dry the Body leſs: and therefore ought to be compoſed of ſuch Simples, as give little diſorder to the Stomach.

Concluſion of the preceding Enquiry.

4. The Intentions of the Operations here propoſed, we conceive to be juſt; and the Remedies preſcribed, very ſuitable to them. And tho many of them may ſeem trifling and vulgar, yet a Man would ſcarce believe with what degree of Care and Choice we have ſat upon and examined them; that they might be not only well adapted, but ſafe and effectual. Experience, however, is what muſt prove, and carry this matter ſtill farther. In all Caſes, the Reſults of deliberate and prudent Conſideration, tho ever ſo admirable in their Effects, and excellent in their Order; conſtantly appear but vulgar and obvious Things when diſcover'd.

SECT.

SECT. IX.

The HISTORY *of the* AVENUES, *or laſt* Approaches of Death; *in proſecution of the* fifteenth *Article of the* Table of Enquiry.

Tranſition.

WE come next to enquire into the *Avenues of Death*; that is, into what happens a little before, a little after, and at the very inſtant a Perſon dies: for as there are many Ways which lead to Death, we ſhou'd underſtand in what common Roads they terminate; eſpecially in ſuch Deaths as are occaſion'd by the Impoveriſhment of Nature, rather than by Violence; tho ſome regard muſt alſo be had occaſionally to the latter, by reaſon of the Connection that one thing has with another.

Three requiſites in a living Spirit.

1. There ſeem three Requiſites to the ſubſiſtence of a *living Spirit*; viz. (1.) A commodious Motion. (2.) A temperate Coolneſs, or Refreſhment: and (3.) A proper Aliment. Flame appears to require but two of theſe; *viz.* Motion and Aliment: for Flame is a ſimple, but Spirit a compound Subſtance; which is deſtroy'd by approaching near to the Nature of Flame [4].

2. (1.) A leſs *Flame* is deaden'd, extinguiſhed, and deſtroyed, by a greater and more powerful one, acting upon it; and the ſame holds yet ſtronger of *Spirits.*

Relation of Flame and Spirit.

3. *Flame* is extinguiſh'd by too great a Compreſſion; as we ſee by inverting a Glaſs upon a Candle: nor will Fire burn in a Grate, when the fewel is preſs'd too cloſe; without leaving ſome ſpace between its Parts.

4. Ignited Bodies are likewiſe extinguiſh'd by Compreſſion: thus a red hot Coal is preſently put out, by ſtrongly compreſſing it with a Fire-ſhovel, or the Foot.

Sudden Deaths cauſed by Extravaſations. Contuſions.

5. But with regard to the Spirits; if any Blood or ſerous Matter gets into the Ventricles of the Brain, 'tis ſudden Death.

6. So likewiſe, great Contuſions of the Head cauſe ſudden Death; by compreſſing the Spirits in the Ventricles of the Brain.

Opium.

7. Opium, and other ſtrong Narcoticks coagulate the Spirits; and deprive them of Motion.

Poiſons.

8. Poiſonous Vapours, which are utterly abominated by the Spirits, alſo cauſe ſudden Death; as we ſee in thoſe kinds of deadly Poiſons that operate by what they call a ſpecifick Malignity: for theſe give ſuch an abhorrence to the Spirits, as to deprive them of Motion; or diſable them from ſtriving againſt a Thing ſo contrary to their Nature.

[4] *See Mr.* Boyle's Works; *Abridgm.* Vol. II. pag. 469, *&c.*

Drunkenneſs. 9. So again, great fits of Drunkenneſs, Surfeiting and Gluttony, ſometimes cauſe ſudden Death; in which Caſes, the Spirits are not ſo much oppreſs'd by the denſity or malignity of the Vapour, (as in Opium, and malignant Poiſons) as by its quantity.

Fear and Sadneſs. 10. So likewiſe extreme Fear and Sadneſs, eſpecially when ſudden; as upon hearing an unexpected Diſaſter; ſometimes occaſion ſudden Death.

Great Dilatations of the Spirits. 11. And not only too great a Compreſſion; but alſo too great a Dilatation of the Spirits proves mortal.

Sudden Joy. 12. Great and ſudden Joys have frequently proved mortal.

Large Evacuations. 13. Large Evacuations, as upon tapping for the Dropſy, when the Water comes away in abundance; but more particularly great and ſudden Hemorrhages, are often followed by ſudden Death. And this ſeems to happen by the way of preventing a vacuity in the Body; whilſt all the Fluids plentifully pour themſelves out, to fill up the emptied Spaces; and among the reſt the Spirits themſelves. And thus much for the Motion of the Spirits, compreſs'd or diſcharged, ſo far as to cauſe Death.

Suffocation. 14. (2.) We next proceed to the *want of Coolneſs*. Stoppage of the Breath proves ſuddenly mortal; as in all Suffocation and Strangulation. And this does not ſeem owing, ſo much to the prevention of Motion, as to the prevention of Cooling; becauſe Air when too hot, tho largely taken in, ſuffocates no leſs than a Stoppage of Reſpiration; as happens in ſuch as are ſometimes ſuffocated by going into cloſe Rooms, where Charcoal Fires have been kept for airing them, or drying the Walls, that were newly plaiſter'd, or white-waſhed: which is a kind of Death ſaid to have befallen the Emperor *Jovinian* [e], And the like happens in *Bagnios*, or dry Bathings, when the Hot-room is over heated: which was a Thing practis'd in the Death of *Fauſta*, Wife to *Conſtantine* the Great.

The Motion of Reſpiration. 15. 'Tis a very ſhort time wherein Nature performs the Act of Reſpiration; or diſcharges the Air received into, and ſpoiled by the Lungs: as deſiring to take in freſh at leaſt twenty times in a Minute.

The Pulſe. 16. The pulſation of the Arteries, and the *Syſtole* and the *Diaſtole* of the Heart, is a Motion three times quicker than that of Reſpiration; whence if it were poſſible to ſtop this Motion of the Heart, without altering that of Reſpiration, a more ſudden Death wou'd enſue than by Strangulation.

Force of Cuſtom in Reſpiration. 17. But Uſe and Cuſtom have a conſiderable Force in this natural Action of Reſpiration; as appears, from the *Delian* Divers, and Fiſhers for Pearl; who by conſtant Practice can hold their Breath, at leaſt ten times longer than other Men.

Reſpiration different in different Creatures. 18. There are ſome Animals, among ſuch as have Lungs, that can hold their Breath for a longer, and others for a ſhorter time; as they require a greater, or leſs degree of Coolneſs, or Refreſhment.

19. Fiſh

[e] Several of later Date have ſuffer'd this kind of Death; by entring ſuddenly into Rooms kept cloſe, with Charcoal Fires in them.

19. Fiſh require leſs cooling than Land Animals; tho they ſtill require ſome, and are refreſhed by their Gills: and as Land Animals endure not a cloſe and over ſultry Air; ſo Fiſhes likewiſe are ſuffocated, when the ſurface of the Water remains for a long time entirely frozen. *Fiſh how refreſh'd.*

20. If the Spirits be attact by any Heat, much greater than the natural, they are thereby diſſipated and deſtroy'd: for if they cannot ſuſtain their own native Heat, without being cool'd and refreſh'd; much leſs can they endure a foreign one, that is more intenſe; as appears in burning Fevers, where the Heat of the corrupted Juices exceeds the natural Heat; ſo far as to diſſipate and conſume the Spirits. *Heat deſtructive to the Spirits.*

21. The want and enjoyment of Sleep has alſo ſome Relation to this Refreſhment: for as Motion attenuates and rarifies the Spirits, and thereby provokes and increaſes their Heat; ſo Sleep, on the contrary, appeaſes and quells their Motion, and Diſorder. For tho Sleep ſtrengthens, and promotes the Actions of the leſs lively Parts and Spirits, and all Motion to the Circumference of the Body; yet it in great meaſure calms and dulls the proper Motion of the living Spirit. But Men regularly require Sleep once in four and twenty Hours; and of five or ſix Hours continuance at leaſt; tho there are ſometimes found Miracles of Nature in this Reſpect. Thus 'tis reported of *Mecænas*, that he ſlept not for a long time before his Death. And ſo much for the want of Coolneſs, requiſite to the preſervation of the Spirits. *Refreſhment by Sleep.*

22. (3.) The third Requiſite, that of *Aliment*, ſeems to regard the Parts, rather than the living Spirit: For it is eaſily believed, that the living Spirit remains identically the ſame; without Succeſſion or Renovation: but for the rational Soul, 'tis certain that this comes not by Propagation; and neither ſuffers Death nor Repair. Men likewiſe talk of a natural Spirit, both in Animals and Vegetables; which differs as well eſſentially as formally, from the other; and from confounding theſe two together have proceeded the Doctrine of Tranſmigration; and numberleſs other falſe and fictitious Notions, among the Hereticks and the Heathens. *Alimentation of the Parts.*

23. The Body in Health, regularly requires a diurnal Renovation by Aliment; and can ſcarce, without detriment, ſuffer three Days faſting: tho Uſe and Cuſtom may make great Alterations in this reſpect. But Want is eaſier endured in a languiſhing Illneſs. And Sleep in ſome meaſure ſupplies the place of Aliment: as Exerciſe, on the contrary, requires it more. There are ſome, however, tho few, who have been found, in a very extraordinary manner, to live a conſiderable time without Meat or Drink. *The Neceſſity of eating.*

24. Dead Bodies, if not prevented by Putrefaction, continue long without any conſiderable waſte; but living ones, as we before obſerved, not much above three Days, unleſs recruited by Aliment: which indicates that quick Conſumption to be the effect of the living Spirit, whilſt it either thus repairs itſelf, or puts the Parts into a Neceſſity of repairing themſelves, or both. And this ſeems confirm'd by the preceding Obſervation, that Animals can ſomewhat longer endure the want of Aliment, by the uſe of *Dead Bodies waſte leſs than live ones.*

Sleep: but Sleep is no more than the Collection of the living Spirit into itſelf.

How large Bleedings prove mortal.

25. A too large and continued Effuſion of Blood; as ſometimes happens from the Hemorrhoides; ſometimes by Vomit, when certain internal Veins are burſt, or their Mouths open'd; and ſometimes by Wounds; cauſes ſudden Death: the venal Blood ſupplying the arterial; and the arterial ſupplying the Spirits.

More taken in than diſcharged in a viſible Form.

26. 'Tis a conſiderable quantity of Meat and Drink that a Man, by two Meals a Day, receives into his Body; and much more than he diſcharges by Stool, by Urine, and by Sweat. If this be not thought ſtrange; as ſuppoſing that the other part may be changed into the Juices of the Body; yet let it be conſidered that this Supply, tho afforded twice a Day, does not overload the Body; and again, that altho the Spirits are recruited; yet theſe alſo do not immoderately increaſe in quantity [f].

The waſte of old Age whence.

27. 'Tis of no ſervice to have Aliment preſent, only in a remote Degree; for it muſt neceſſarily be of ſuch a kind, ſo prepared, and ſo applied, as that the Spirits may act upon it. Thus a Taper wou'd not continue flaming, unleſs immediately fed with Wax: nor can a Man be well nouriſhed by Herbage alone. And herein conſiſts the waſte of old Age; *viz.* that tho there be no want of Fleſh and Blood, yet the Spirits are prepared in ſuch a ſmall and ſcanty Proportion, and the Blood and Juices are grown ſo exhauſted, dry and balmleſs, that they cannot ſupply the demands of Alimentation.

The Requiſites to Life ſum'd up.

28. Let us now ſum up the Requiſites to Life, according to the common and ordinary courſe of Nature. (1.) The Spirits continually require, an expanſive Motion in the Nerves and Ventricles of the Brain. (2.) The pulſation of the Heart, is required ſixty times in a Minute. (3.) Reſpiration, twenty times in a Minute. (4.) Sleep and Aliment, once in three Days. And, (5.) A Power of Alimentation, ſuppoſe after eighty Years of Age. And if any of theſe Requiſites are wanting, Death enſues. But there ſeem to be three more certain and evident *Avenues of Death*; viz. (1.) Want of Motion in the Spirits. (2.) Want of Coolneſs, or Ventilation. And, (3.) Want of Aliment.

Admonitions.

(1.) 'Tis an Error to imagine, that a living Spirit ſhould be perpetually generated and extinguiſhed, like Flame; without being able to laſt for ſome conſiderable Time. Even Flame itſelf is not thus generated, of its own Nature; but only becauſe it acts among things that are not favourable to it; for one Flame is durable in another: but the living Spirit reſides among things that greatly affect and delight it; and therefore, as Flame is a momentary, and Air a permanent Subſtance, the living Spirit ſeems to be of a middle Nature between both.

(2.) We obſerved at firſt ſetting out, that the preſent Enquiry was not concerned with the decay of the Spirits, occaſioned by the deſtruction of the

[f] This leads up to the Doctrine of inſenſible Perſpiration.

the Organs, thro' Diſtempers and Violence; tho this alſo terminates in the ſame three Avenues. And thus much for the *Form* and *Nature of Death.*

28. There are two grand *Harbingers of Death*; the one detached from the Head, the other from the Heart; *viz. Convulſions*, and a *labouring Pulſe:* for the *mortal Hiccup* is a kind of Convulſion. And the *mortal labouring of the Pulſe* has a remarkable Quickneſs; the Heart trembling towards the Article of Death; and almoſt confounding its *Syſtole* and *Diaſtole.* This *dying Pulſe* is alſo attended with a Debility and Lowneſs; and frequently a great intermiſſion of the Stroke: the Motion of the Heart then failing; or being no longer able to riſe with ſtrength and regularity. *The Fore-runners of Death.* *Convulſions, and a labouring Pulſe.*

29. Death is likewiſe preceded, and denoted near at hand, by great Inquietude and toſſing of the Body; a catching, unſteddy Motion of the Fingers, as if to take up ſomewhat from the Bed-cloths; graſping hard, and holding ſtrong with the Hands; grinding of the Teeth; a hollow Voice; trembling of the Under-jaw; paleneſs of the Face; confuſion of the Memory; loſs of Speech; cold Sweats; ſhooting out of the Body in length; turning up of the Whites of the Eyes; an alteration of the whole Countenance; or a pinching in of the Noſe; hollowneſs of the Eyes; ſinking of the Cheeks; contraction and rolling of the Tongue; coldneſs in the extreme Parts; ſometimes a diſcharge of Blood, *&c.* Shrieking, Gaſping, and fetching the Breath thick; falling of the Lower-jaw, and the like. *Symptoms of Death.*

30. Upon Death their follows a deprivation of all Senſe and Motion, as well of the Heart and Arteries as of the Nerves and Limbs; an inability of the Body to ſuſtain itſelf erect; a ſtiffneſs and coldneſs of the Parts; a loſs of Colour; and, ſome time after, Putrefaction and Stench. *Conſequents upon Death.*

31. Eels, Serpents, and Inſects, continue to move in all their Parts, a long time after being cut aſunder. Birds, likewiſe, flutter for a while after their Heads are ſtruck off; and the Hearts of Animals will long continue to beat, after being ſeparated from their Bodies. I remember myſelf to have ſeen a Man quartered and diſbowelled, for Treaſon; when his Heart being thrown into the Fire, it ſprung upwards; firſt to the height of about a Foot and a half, and then by degrees a leſs height, for the ſpace, as I judge, of two or three Minutes. There goes an ancient, and no improbable Tradition of an Ox, that lowed when his Entrails were taken out. Yet this appears leſs certain than what is related of a Traitor, who was heard to pronounce three or four Words of Prayer, after his Heart was ſeparated from the Body, and remained in the Hand of the Executioner. We judge this Relation more credible than the former, of the Ox's lowing under the Hands of the Sacrificer; becauſe the Friends of the Perſons publickly executed, uſually Fee the Executioner, to perform his Office with the utmoſt expedition, and not keep the Malefactor long under Torture: whereas there appears no reaſon why the like Diſpatch ſhould be made in the caſe of Sacrifices. *The remains of Life ſoon after Death.*

32. The following things are in uſe for recovering Perſons from Apoplexies and Faintings; many of whom, without Relief, might die in the Fit; *viz.* the exhibiting of ſpirituous Cordial-waters; bending the Body forwards; *Means of recovering from apparent Death.*

wards; ſtopping and ſtrongly compreſſing the Mouth and Noſtrils; bending the Fingers, backward, ſo as to give Pain; twitching off ſome Hairs of the Head or Beard; rubbing the Parts, eſpecially the Face and Extremities, briſkly; the quick ſprinkling of cold Water upon the Face; ſudden and ſhrill Noiſes; the applying of Roſe-water and Vinegar to the Noſe, in caſe of Fainting; and burning Feathers or woollen Cloth under it, in hyſterick Fits: but principally, the application of a heated Salamander, Shovel, or Warming-pan Bottom, near the Head, is ſerviceable in Fits of the Apoplexy.

Perſons ſuppoſed dead, have recovered,

33. There are many Examples of Men left for dead, laid out, and even buried, who have yet come to life again. This has been diſcovered, in ſuch as were buried, upon opening the Ground ſoon after, and finding Bruiſes and Wounds on the Head; from the ſtruggling of the Body in the Coffin. We had a late and very memorable Example of this, in the Perſon of that ſubtil Schoolman *Johannes Scotus*; who being buried in the abſence of his Servant, that ſeemed to have known him ſubject to ſuch kind of Trances; this Servant, ſome time after, opened the Grave, and found the Body bruiſed and wounded. The like happened in our Time, in the Perſon of a Player buried at *Cambridge*. And a certain Gentleman once told me, that having a deſire to know what Hanging was; he, by way of Curioſity, and without any ill Deſign upon himſelf, reſolved to make ſome trial of it; and to this purpoſe ſuſpending a Cord, and faſtening it about his Neck, he mounted a Stool, and ſwung himſelf off; conceiving it in his power to recover the Stool again, when he pleaſed: but he failed in his Expectation; and was relieved by the aſſiſtance of a Friend then preſent. Being aſked, what he underwent in that Condition? he anſwered, he felt no Pain; but firſt perceived a kind of Fire, and burning before his Eyes; then an extreme Blackneſs, or Darkneſs; and laſtly, a kind of pale, blue, or ſea-green Colour; which is alſo frequently perceived by Perſons in fainting Fits. And a Phyſician aſſured me, that by the uſe of Frictions, and hot Bathing, he had brought a Man to Life again, who hanged himſelf, and had continued hanging for half an Hour. This Phyſician farther declared, that he made no queſtion of recovering any Perſon hanged up for the ſame time; provided his Neck were not broken by the fall, or ſtretch of the Rope [z].

[z] The Inſtances of this kind ſhould be carefully collected; in order to gain as much light as poſſible into the Tranſaction at the Point of Death.

SECT.

SECT. X.

Of the Differences *between* YOUTH *and* OLD-AGE; *with regard to the ſixteenth Article of the* Table of Enquiry.

The natural Progreſs of Life.

1. THE Scale, or Progreſſion, of human Life is this: Conception; Quickening; Birth; Lactation; Weaning; Feeding by Hand; Dentition, for the firſt time, at about two Years old; Beginning to walk; Beginning to ſpeak; Dentition the ſecond time, at about the Age of ſeven; Puberty about twelve or fourteen; Capacity for Generation; The menſtrual Flux; The growth of Hair upon the Legs and Arms; Signs of a Beard; Growth of Stature to this State, and ſometimes longer; Perfection of Strength, and Agility of Body; Greyneſs and Baldneſs; Ceſſation of the *Menſtrua*, and power of Generation; decrepid Age; Walking with a Stick; Death. The Mind likewiſe has its ſeveral Periods, tho incapable of being deſcribed by the numeration of Years; ſuch as decay of Memory, *&c.* of which more preſently.

Youth and Age compared.

2. The Differences between Youth and Age are theſe.

In Youth the Skin is ſmooth and equal; but in Old-Age, dry and wrinkled; eſpecially about the Eyes and Forehead.

In Youth the Fleſh is ſoft and tender; but in Old-Age hard and dry.

Young Men are ſtrong and healthy; but old ones weaker, and ſlow of Motion.

In Youth the Concoctions are well performed; but in Old-Age weakly.

In Youth the *Viſcera* are ſoft and ſucculent; but in Old-Age dry and parched.

In Youth the Body is ſtrait and upright; but in Old-Age bent, or curved.

In Youth the Limbs are firm and ſteddy; but in Old-Age, relaxed and trembling.

In Youth the Humours are bilious, and the Blood is hot; but in Age the Humours are aqueous and melancholick; and the Blood is colder.

In Youth there is a ready diſpoſition to Venery; but in Old-Age, a flower.

In Youth the Juices of the Body are more balmy; but in Age more crude, and watery.

In Youth the Spirit is copious and turgid; but in Old-Age poor and little.

In Youth the Spirit is denſe and freſh; in Old-Age more rarified, and eager.

In Youth the Senſes are entire and lively; but in Age dull and faulty.

In Youth the Teeth are ſtrong and ſound; but in Age worn and decay'd.

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In Youth the Hair is always coloured; but in Old-Age, grey or white.

Youth is attended with Hair on the Head; but Old-Age, with Baldneſs.

In Youth the Pulſe is ſtrong and quick; but in Old-Age fainter and ſlower.

In Youth Diſeaſes are more acute and curable; but in Old-Age more chronical, and harder of cure.

In Youth Wounds heal faſter; but in Old-Age ſlower.

In Youth the Cheeks are florid; but in Old-Age pale, or of a deep red, by reaſon of the Blood thickening and ſettling in them.

Catarrhs are leſs frequent in Youth; but more troubleſome in Old-Age.

Nor can we recollect in what reſpect Old-Age improves the Body; unleſs ſometimes in Corpulency: the reaſon whereof is obvious; becauſe the Body in Old-Age neither perſpires freely, nor aſſimilates kindly; whilſt Fat is nothing but a redundancy of the Aliment, over and above what is diſcharged, or perfectly aſſimilated. Sometimes alſo there is an increaſe of Appetite in Old-Age, thro' the acidity of the Juices: for old Men do not digeſt well. But Phyſicians lightly attribute all the Particulars above-mentioned, to the diminution of natural Heat and radical Moiſture; which is an empty Notion, of no Uſe at all. Thus much is certain, that in declining Age, Coldneſs precedes Dryneſs; and that the Body, when in the higheſt pitch and perfection of its Heat, declines to Dryneſs; whilſt Coldneſs ſucceeds afterwards.

The difference of Affections betwixt Old and Young.

3. We are next to conſider the Affections and Diſpoſitions of the Mind. When I was a young Man, at *Poictiers* in *France*, I familiarly converſed with a young Gentleman of that Country, who was extremely ingenious, but ſomewhat talkative: he afterwards became a Perſon of great eminence. This Gentleman uſed to inveigh againſt the Manners of old People; and would ſay, that if one could ſee their Minds, as well as their Bodies, their Minds would appear as deformed as their Bodies: and, indulging his own Humour, he pretended that the defects of old Mens Minds, in ſome meaſure, correſponded to the defects of their Bodies. Thus, Dryneſs of the Skin, he ſaid, was anſwered by Impudence; Hardneſs of the *Viſcera*, by Relentleſneſs; Blear-eyes, by Envy and an evil Eye; their Down-look and Incurvation of the Body, by Atheiſm; as no longer, ſays he, looking up to Heaven; the trembling and ſhaking of the Limbs, by Unſteddineſs and Inconſtancy; the bending of their Fingers, as to lay hold of ſomething, by Rapacity and Avarice; the Weakneſs of their Knees, by Fearfulneſs; their Wrinkles, by indirect Dealings and Cunning, *&c.*

But, to be ſerious, young Men are modeſt and baſhful; old ones, not ſo tender of Countenance.

Young Men are generous and commiſerating; but old ones cloſe, and harder of Heart.

Young Men have a laudable Emulation; but old ones an ill-natured Envy.

Young Men are inclined to Religion and Devotion; as being warm in themſelves, and unexperienced in Misfortunes; but old ones grow colder

in

in Piety, thro' want of Charity, a long converſation with Evils, and a hardneſs of Belief.

Young Men are reſolute; old Men more moderate.

Young Men have a certain Levity and Inſtability; old ones a greater Gravity and Conſtancy.

Young Men are liberal, beneficent, and Lovers of their Species; old ones are covetous, wiſe for themſelves, and firm to their own Intereſt.

Young Men are full of Hope and Confidence; but old Men diffident, and in moſt caſes diſtruſtful.

Young Men have an eaſy and obliging Carriage; but old Men are churliſh, peeviſh, and diſdainful.

Young Men are ſincere, and ſpeak their Minds; but old Men are cautious and reſerved.

Young Men affect great Undertakings; but old ones take care of ſuch Things as are neceſſary.

Young Men favour Things preſent; but old ones rather affect former Tranſactions.

Young Men reverence their Superiors; but old Men cenſure them.

There are numerous other Differences, which belong rather to Morality than the preſent Enquiry. Yet as old Mens Bodies improve in ſome reſpects, ſo likewiſe do their Minds; unleſs quite worn out: for Example, tho they are leſs ready at Invention, they are ſtronger in Judgment; and chuſe ſuch things as are ſafe and ſolid, before ſuch as are ſpecious and ſhowy. They likewiſe improve in Talkativeneſs, and the Art of ſhewing themſelves to advantage; and, becoming now unfit for Buſineſs, reap the fruits of Diſcourſe: whence the Poets aptly feigned the Transformation of *Tithonus* into a Graſs-hopper.

SECT. XI.

Improveable AXIOMS, *or* Variable CANONS, *formed upon the* preceding Hiſtory; *for giving Light into the Cauſe of the* Continuance *or* Duration of LIFE, *and the true* Nature, *or* Form, of DEATH[h].

AXIOM I.

There is no Conſumption, unleſs what is loſt by one Body paſſes into another.

EXPLANATION.

Waſte, how cauſed, and prevented.

THERE is no ſuch thing as Annihilation in Nature; and therefore in all Conſumption, the Parts conſumed either fly off into the Air, or are received into ſome adjacent Body. Thus we ſee Spiders, Flies, Ants, *&c.* included, and eternized in Monuments of Amber; tho theſe are tender and diſſipable Bodies: but then there is no Air in contact with them, for their Parts to eſcape into; and the Subſtance of the Amber is ſo heterogeneous as to receive none of them. And the like Effect, we judge, might be procured by burying Wood, or the like, in Quickſilver: but Wax, Honey, and Gums, have this Effect only in part[i].

AXIOM II.

All tangible Bodies contain a Spirit, covered over, and inveloped with the groſſer Body; and this Spirit it is that gives Origin to Conſumption and Diſſolution.

EXPLANATION.

Spirit the cauſe of Waſte and Diſſolution.

THERE is no known Body, in the upper parts of the Earth, without its Spirit; whether it be generated by the attenuating and concocting Power of the celeſtial Warmth, or otherwiſe: for the Pores of tangible Bodies

[h] This Section contains a kind of Recapitulation, or conciſe Abridgment, of the preceding Hiſtory; drawn up with new Enforcements, and ſet in a fuller light; whence a Judgment may be the readier form'd thereof. And certainly it muſt be a pregnant Hiſtory, to afford ſuch a number of AXIOMS, that ſeem a little Compendium of *Natural Philoſophy*; at the ſame time that they unfold, and explain, ſome of the great Myſteries of Life and Death. And hence alſo a tolerable Judgment may be formed of the Deſign of the *Sixth Part* of the INSTAURATION, which was to receive a Collection of ſtill more perfect AXIOMS, after they had been thoroughly verified, or render'd preciſely juſt; at leaſt ſo juſt as not to fail in Practice.

[i] Theſe AXIOMS require a conſiderable Attention to perceive their full Meaning and juſt Value; a greater to improve and verify them, where they may require it; and a greater ſtill

Bodies are not a *Vacuum*; but either contain Air, or the peculiar Spirit of the Subſtance. And this Spirit is not a Virtue, an Energy, a Soul, or a Fiction; but a real, ſubtile, and inviſible Body, circumſcribed by Place and Dimenſion. Nor again is this Spirit Air, any more than the Juice of the Grape is Water; but a fine attenuated Body, of kin to Air, tho again, very different from it: for the groſſer Parts of the Subject being of a ſluggiſh and not very moveable Nature, would endure to a long Period, did not this Spirit rouze, ſtimulate, undermine them, and prey upon the moiſture of the Body, and whatever elſe it can digeſt and convert into new Spirit; till at length, both the Spirit before included in the Body, and that newly formed, gradually fly away together. This is excellently demonſtrated from the Diminution of the Weight of dry Bodies, thro' Perſpiration: for all that which flies away, was not Spirit at the time of weighing the Body; but was Spirit when it flew off [k].

AXIOM III.

The Avolation of the Spirit of Bodies cauſes Dryneſs; but whilſt this Spirit is detained and operates within, it either diſſolves, putrefies, or vivifies the Body.

EXPLANATION.

THERE are four Proceſſes of the Spirit; *viz.* (1.) that of Drying; (2.) that of Diſſolving; (4.) that of Putrefying; and, (4.) that of Generating Bodies. *Four Operations of the Spirit*, viz.

(1.) *Arefaction* is not the proper Operation of the Spirit; but of the groſſer Parts, after the Spirit is diſcharged: for upon this they contract themſelves, partly to fill up Vacuities; and partly thro' an Appetite which homogenous Bodies have to unite; as appears in all Bodies dried by Age, and in the firmer Bodies which are dried by Fire; as Bread, Charcoal, Bricks, *&c.* *Arefaction.*

(2.) But *Colliquation* is a mere Work of the Spirits; and not performed without the Animation of Heat; whereby the Spirits dilate themſelves, yet without flying off; and inſinuate and ſpread among the groſſer Parts; thus rendering them ſoft and fuſible; as we ſee in Metals and Wax: for Metals, and other tenacious Bodies, are fitted to hold in the Spirit; and to prevent its Avolation when excited. *Colliquation.*

ſtill to explain them ſo as to render them univerſally intelligible; and draw them out into familiar Rules of Practice, for operating effectually in the grand Deſign of prolonging Life.

[k] This Inſtance we meet with in Nuts, the Stones of Fruit, *&c.* where the Kernel dries and withers, as the Spirit perſpires thro' the Shell and outward Coats; without the entrance or admiſſion of the external Air. This AXIOM relating to the Spirits of Bodies deſerves a particular regard. And let not any modern Diſcoveries be too raſhly imagined to have ſet the Doctrine of Spirits aſide; whereon, perhaps, the Improvement of natural Philoſophy principally depends. See the *Sylva Sylvarum*, under the Articles NATURE, SPIRIT, SYMPATHY, *&c.*

Putrefaction. (3.) *Putrefaction* is a mixed operation of the Spirit, and groſſer Parts; for when the Spirit, which reſtrained and held the parts of a Body together, is partly diſcharged and partly render'd languid, all things are diſſolved, and return to their heterogeneous Principles; for now the Spirit contained in the Body gathers to itſelf; the oily Parts to themſelves; the aqueous alſo to themſelves; and the Fæces to themſelves; upon which neceſſarily enſues that cadaverous Odour, that unctuoſity, ſlimineſs, and confuſion of Parts obſervable in Putrefaction [1].

And Generation. (4.) *Generation* likewiſe, or Vivification, is a mixed Operation of the Spirits and groſſer Parts; but in a quite different manner: for in this caſe the Spirit is totally held in, (but ſtill expands and moves itſelf,) whilſt the groſſer Parts are not diſſolved, but obey the motion of the Spirit; whereby they are ſwelled, and thruſt out into various Figures: whence proceeds Generation and Organization. And, therefore, Vivification is always wrought upon a tenacious, viſcous Matter, tho ſoft and yielding; fit at once to detain the Spirit, and yet gently yield thereto; as the Spirit forms its Parts. And this appears in the Matter of all Vegetables and Animals, whether generated in Putrefaction, or from Seed; in all which there manifeſtly appears a Subſtance which is hard to ſeparate, but eaſy to yield.

AXIOM IV.

All animate Bodies have two kinds of Spirits; viz. *a lifeleſs Spirit, ſuch as reſides in Bodies inanimate; and a vital Spirit, ſuperadded to it.*

EXPLANATION.

The Two Spirits in Bodies. 1. WE formerly obſerved, that in order to procure long Life, the human Body ſhould firſt be conſidered as a Body inanimate, and unrepairable by Aliment; and again, as a Body reparable and nouriſhable: for the former Conſideration ſupplies the *Laws of Conſumption*; and the ſecond the *Laws of Repair*. We are, therefore, to underſtand, that all the parts of the Body, the Fleſh, the Bones, the Membranes, the Organs, *&c.* have each of them, whilſt alive, ſuch Spirits diffuſed thro' their Subſtance, as are proper to them reſpectively, when ſeparated, and dead, and ſuch as remain even in the Carcaſs: but the *vital Spirit*, tho it preſides over, and has a certain agreement with them, is yet a very different thing; as being entire, and ſubſiſting of itſelf.

The Differences betwixt the lifeleſs and the vital Spirits. 2. There are two principal Differences betwixt the *lifeleſs* and the *vital Spirits*; the one, that the lifeleſs Spirits are not continued in themſelves, but in a manner cut off and ſurrounded by the groſs Body that intercepts them; like Air mixed in among Snow or Froth: but all the vital Spirit is continued

[1] See the Nature of Putrefaction, in the *Philoſophical Tranſactions*; or *Boerhaave's* Chemiſtry, Proceſs 88.

tinued in itſelf, thro' certain Canals, which it penetrates without being totally intercepted. And this Spirit alſo is of two kinds; the one only branching out, and ſtriking thro' little Tubes, and, as it were, ſingle Threads: but the other has alſo certain Cells; ſo as not only to be continued with itſelf, but likewiſe copiouſly collected, in proportion to the Body, into Cavities which ſerve as Fountains to numerous Rivulets running from them. The principal Cells, or Cavities, of this kind, are ſeated in the Ventricles of the Brain; which in the more ignoble Creatures are narrow; ſo that their Spirit ſeems diffuſed over the whole Body, rather than contained in Cells; as appears in Serpents, Eels, and Flies, which, when cut to pieces, long continue moving in all the ſeparated Parts: even Birds continue ſtruggling for a while, after their Heads are off; becauſe they have little Heads, and little Cells of Spirits. But the more noble Animals have theſe Ventricles ſtill larger; and Man the largeſt of all [m].

Two kinds of vital Spirit.

3. The other Difference between the Spirits is, that the *vital Spirit* has ſome kind of Inflammability, and reſembles a Breath compoſed of *Flame* and *Air*; as the Juices of Animals contain both Oil and Water. And this kind of Inflammability is attended with peculiar Properties and Motions; for even inflammable Smoke is warm, ſubtil, and moveable, before it catches Fire, and turns to Flame; yet becomes a different thing when changed to Flame. But the kindling of the vital Spirits is, by many degrees, more gentle than the ſofteſt Flame, even that of Spirit of Wine: and is alſo largely mixed with an aerial Subſtance, ſo as to become a peculiar and almoſt inexplicable Union, of a flamy and aerial Nature.

A ſecond Difference betwixt the Spirits.

AXIOM V.

All the parts of the Body have their proper and reſpective natural Actions; but each of them is excited and quickened by the vital Spirit.

EXPLANATION.

THE Actions or Functions of any Part are correſpondent to the Nature of that Part; ſuch as Attraction, Retention, Digeſtion, Aſſimilation, Separation, Excretion, Perſpiration; and even the Senſes themſelves, according to the Properties of every Organ; as the Stomach, Heart, Spleen, Brain, Ear, Eye, *&c.* Nor could any of theſe Actions be excited and performed without the animating Vigour and Preſence of the vital Spirit, and its Heat; no more than one piece of Iron could attract another, unleſs firſt animated by the Loadſtone; or an Egg produce a Chick, unleſs the Subſtance of the Hen were firſt actuated by the treading of the Cock.

The Office of the vital Spirit.

AXIOM

[m] Let theſe AXIOMS and *Explanations* by no means be lightly cenſured, and rejected as conjectural things; they are meant to be deduced from the preceding Hiſtory, in the ſtrict and genuine way of interpreting Nature.

AXIOM VI.

The lifeleſs Spirits *are nearly of the ſame Subſtance with Air; but the* vital Spirits *approach nearer to the Subſtance of Flame.*

EXPLANATION.

The Subſtance of the Spirits.

THE Explanation of the preceding fourth *Axiom*, is alſo explanatory of this. But hence it is, that all fat and oily Subſtances continue long in their own State; as the Air does not greatly operate upon them, nor they themſelves greatly incline to mix with the Air. But that is an empty Conceit which ſuppoſes Flame to be kindled Air; for Flame and Air are as heterogeneous as Oil and Water. The Senſe of the preſent *Axiom* therefore is, that the vital Spirits only approach nearer to the Subſtance of Flame than the lifeleſs Spirits do; and not that they are more of a flamy than aerial Nature.

AXIOM VII.

Spirit has two Appetites; the one an Appetite of multiplying itſelf; the other an Appetite of quitting the Body, and aſſociating with Subſtances of its own Nature.

EXPLANATION.

The two Appetites of the Spirits.

1. THIS *Axiom* is underſtood of the lifeleſs Spirits; for as to the ſecond Appetite, the vital Spirit has a great abhorrence of quitting the Body; nor can it find Subſtances of its own Nature near at hand: it may ſometimes perhaps ruſh to the extremities of the Body, to meet a thing it affects; tho it is averſe to going out. But both theſe Appetites reign in the lifeleſs Spirits. As for the firſt; no Spirit is commodiouſly lodged among groſs Bodies; and therefore when it finds nothing of its own Nature, it labours ſo much the more, in this Solitude, to multiply itſelf, or to create, or produce its like; and thus briſkly preys upon the more ſubtil Parts of the groſs Bodies, in order to increaſe its own Quantity.

2. As to the *ſecond* Appetite; that of Eſcaping, and flying off into the Air; 'tis certain, that all attenuated Bodies, which are ever moveable, willingly move to their like, when near adjoining; as Flame, to Flame; and one Bubble of Water to another: but this happens much more in the Avolation of the Spirits into the external Air; as not tending only to Particles of a like Nature; but, as it were, to an Ocean of matter homogeneous to itſelf. Let it however be obſerved, that the exit and eſcape of the Spirit into the Air is a double Action; proceeding partly from the Appetite of the Spirit, and partly from the Appetite of the Air: for the common

common Air is a hungry thing; and greedily drinks in and receives Spirits, Odours, Rays of Light, Sounds, *&c.*

AXIOM VIII.

When a Spirit is detained, and finds no possibility of producing more Spirit; it mollifies even the grosser Parts.

EXPLANATION.

The Method of mollifying the harden'd Parts.

NEW Spirits are only produced upon such things, as approach, in a tolerable degree, to Spirit; as humid Bodies do: and therefore if the grosser Parts, wherein the Spirit lodged, are far removed from this degree; tho the Spirit cannot work, and convert them into its own Nature, still it saps, softens, and resolves them; and tho it cannot thus increase its own Quantity, yet it resides therein more loosely, and lodges among such Parts as are most favourable to it. And this *Axiom* is extremely conducive to our purpose; as leading to a Method of mollifying the stubborn and dry Parts of the Body, by keeping in the Spirits [n].

AXIOM IX.

The Business of softening the harder Parts, is best carried on, when the Spirit neither flys off nor begets a new Supply.

The Business of Malaxing, how best performed.

THIS *Axiom* solves the Difficulty in the Operation of malaxing, by detaining the Spirit; for if the Spirit, being detained, should prey upon all within, there is no Advantage procured by suppling the Parts in their Substance; but they are rather dissolved and corrupted thereby: and therefore, besides detaining the Spirits, they must also be cooled, and constringed, to prevent their too great Activity.

AXIOM X.

The Heat of the Spirit, for preserving the Body in a fresh and youthful State, ought to be robust; but not sharp, or predatory.

EXPLANATION.

The Heat required for preserving the Body young.

THIS *Canon* also has a Tendency to solve the Difficulty above mention'd; but is also of much more extensive Use; as describing what ought to be the temper of Heat in the Body, to dispose it for long Life. And this temper

[n] Observe, all along, that Practice is the End at which the whole *Enquiry*, and these *Axioms* drive.

temper of Heat is proper, whether the Spirits be kept in or not: for in either Caſe their Heat ſhou'd be ſuch, as may rather act upon the Solids, than prey upon the Fluids; as the former mollifies, but the latter drys up. The ſame Temper, alſo, is of Service in the due performance of Alimentation; as ſuch a Heat beſt excites the Faculty of aſſimilating; and at the ſame time excellently prepares the matter for Aſſimilation. The Properties required in this Heat are; (1.) That it be ſlow, and do not act of a ſudden; (2.) That it be not intenſe, but moderate; (3.) That it be equable, not acting unſteddily, or by fits of Increaſe and Decreaſe; and (4.) If it find any Reſiſtance, that it ſhou'd not eaſily grow languid, or become extinct. This is an Operation of great Subtility, and of no leſs Uſe: We have therefore had a regard to it; and hope, in ſome meaſure, to have anſwered the Intention, by the Remedies, above propoſed, for giving the Spirits this robuſt, unconſuming and effective Heat.

AXIOM XI.

A Condenſation in the Subſtance of the Spirits, is conducive to long Life.

EXPLANATION.

A Condenſation of the Spirits required to long Life.

THIS *Axiom* is ſubſervient to the former; as a denſe Spirit admits all the four Properties of Heat there mentioned. But for the ways of condenſing the Spirits, we have deſcribed them above, under the firſt of the ten Operations.

AXIOM XII.

When the Spirits are copious, they haſten to eſcape faſter, and prey upon the Body, more, than when their quantity is ſmall.

EXPLANATION.

THIS *Axiom* is clear of itſelf; ſince quantity, of courſe, increaſes Efficacy. And we ſee in Flames, that a greater breaks out more forcibly, and conſumes its Fewel ſwifter than a ſmall one: and, therefore an over Proportion, or Redundancy of Spirits, is very prejudicial to long Life. Nor ſhou'd a larger quantity of Spirits be deſired, than may ſupport the Offices of Life; and ſecure a good Repair.

AXIOM XIII.

A Spirit equally diffuſed thro' the Body, haſtens leſs to eſcape, and conſumes the Body ſlower, than when unequally diſtributed.

EXPLANATION.

Fine Spirits conſume the leſs.

NOT only an over-Proportion of the Spirits, with regard to the whole, ſhortens the duration of Things; but alſo the ſame quantity leſs ground or broken: and therefore the more the Spirit is comminuted, and diſperſed thro' the finer Veſſels and Fibres; the leſs it conſumes. For Reſolution and Decay always begin in the part, where the Spirit is weak or wanting; and therefore Exerciſe and Frictions contribute much to long Life. For all Motion and Agitation excellently grind, and intimately mix Things together in their ſmalleſt Particles.

AXIOM XIV.

An irregular and ſubſultory Motion of the Spirits, tends more to their eſcape, and proves more conſuming, than a Motion that is conſtant and equable.

EXPLANATION.

Irregular Motion more conſuming than regular.

THIS *Axiom* holds with certainty in Bodies inanimate; for unequability is the Parent of Diſſolution: but in animate Bodies it holds leſs ſtrictly; becauſe in theſe, there is not only a Conſumption, but a Repair to be conſider'd: and Repair depends upon the Appetite of Things; and Appetite is ſharpen'd by Variety. But here alſo the *Axiom* may be admitted ſo far, that this Variety ſhould rather be a regular Interchange than a Confuſion; and as it were a conſtant Inconſtancy.

AXIOM XV.

The Spirit is detain'd in Bodies of a firm and cloſe Texture, tho unwillingly.

EXPLANATION.

The Spirits how to be detained in the Body.

ALL Things dread a Solution of their Continuity; tho this according to their degree of Condenſation or Rarifaction: for the more Bodies are rarefied, the leſſer Pores they will paſs, or be driven thro', by Compreſſion. Hence Water and Air will enter where Duſt will not; and

Flame and Spirit, where Air and Water will not. But this matter is limited; for Spirit has not ſo ſtrong an Appetite of eſcaping, as to ſuffer too great a diſcontinuation; or be driven thro' Pores that are too cloſe and ſtrait: and therefore if Spirit be lodged in a hard Body, or ſuch an one as is unctuous, and viſcous, that will not eaſily ſeparate; 'tis then withheld, impriſon'd, and exerts not its Appetite of eſcaping. Whence we ſee that Metals and Stones will not, for a very long time, let go their Spirit; unleſs it be either excited by Fire; or the groſſer Parts of thoſe Bodies be ſeparated, and diſjoin'd, by corroſive Liquors. And the like holds of tenacious Bodies, ſuch as Gums; only theſe are diſſolved by a gentler Heat. And therefore, robuſt Juices of the Body, a conſtringed Skin, and the like, (which are procured by a drying Aliment, Exerciſe and cold Air,) prove ſerviceable in prolonging Life; by ſhutting up the Pores upon the Spirit, and preventing its eſcape.

AXIOM XVI.

The Spirit is willingly detain'd in fat and unctuous Bodies; tho they be not viſcous.

EXPLANATION.

The Spirit willingly reſides in Fat.

IF the *Spirit* be neither irritated by any Antipathy it has to the Body that ſurrounds it; nor fed by too great a ſimilitude with the Subject itſelf; nor ſollicited by any thing external; it becomes not very tumultuary to get out: but *oily Bodies* want all theſe Properties; as being not ſo oppoſite to the Spirit, as hard Bodies are; nor having ſuch an Affinity thereto, as aqueous ones have; nor greatly agreeing with the external Air *.

AXIOM XVII.

Oily Bodies are long preſerved in a State of Perfection, by a quick diſcharge of their aqueous Moiſture.

EXPLANATION.

A Diſcharge of aqueous Moiſture tends to preſervation.

WE juſt now obſerved, that aqueous Moiſture, as approaching nearer to the Subſtance of the Air, flies off faſter than ſuch as is oily; which has a leſs agreement with the Air: but as both theſe Moiſtures are lodged in moſt Bodies, it happens that the aqueous betrays the oily Moiſture;

* It may be well worth conſidering how extenſive this *Axiom* is; and how it agrees with the antient and later Diſcoveries, as to the native Spirits of Bodies. See, in particular, the Proceſſes upon Vegetables, in *Boerhaave's Chemiſtry*. See alſo Proceſs 121.

ſture; and gradually eſcaping, carries that away along with itſelf: whence nothing is more conducive to the preſervation of Bodies than to dry them gently; which breathes out the watry Parts, without diſturbing or affecting the oily. And this not only tends to prevent Corruption; as it does by Conſequence; but alſo to preſerve Bodies in a freſh and vigorous State. And hence it is, that gentle Frictions, and moderate Exerciſe, uſed ſo as to promote Perſpiration rather than Sweat, greatly conduce to prolong Life.

AXIOM XVIII.

To exclude the Air from the Body, contributes to Longevity; if other Inconveniences be prevented.

EXPLANATION.

Excluſion of the Air tends to lengthen Life.

WE lately obſerved [p], that the eſcape of the Spirit is a double Action, ariſing from an Appetite both of the Air, and Spirit; it is therefore of conſiderable Service, if one of theſe Appetites can be deſtroy'd. This is chiefly to be expected from Unctions: but the Uſe thereof is attended with various Inconveniences; which we have endeavour'd to prevent under the *ſecond* of our *ten Operations.*

AXIOM XIX.

By introducing juvenile Spirits into an old Body, the Courſe of Nature may be expeditiouſly put back.

EXPLANATION.

An Intimation of a ſhort Method of prolonging Life.

THE Spirits are like the Maſter-wheel, that carries the other Wheels round in the Body: and therefore theſe ought to ſtand firſt in the Intention of prolonging Life. We may add, that there is an eaſier and more compendious way of altering the Spirits than the other Parts: for the Operation upon the Spirits is of two Kinds; the one by Aliment, which is ſlow, and effected by a Circuit; the other by Vapours, which is ſudden, and reaches the Spirits directly and immediately. To this alſo may be added, the way of operating by the Affections, or Paſſions of the Mind.

[p] See *Axiom* VII.

AXIOM XX.

Hardneſs or Firmneſs, and Roſcidity or Balmineſs, in the Juices of the Body, contribute to prolong Life.

EXPLANATION.

Balmy Juices to be procured.

THE Reaſon hereof is plain; ſince, as we have above obſerved, hard or firm, and balmy or unctuous Bodies, are diſſipated with difficulty. There is however this Difference, tha tho hardiſh and firm Juices are leſs diſſipable, they are at the ſame time leſs reparable; which adds an Inconvenience to a Convenience; and therefore nothing extraordinary can be perform'd by means of hard Juices: but a balmy Juice will anſwer both Intentions; and therefore great regard muſt be had to the procuring of it.

AXIOM XXI.

Balmy Juices are procured by ſuch Things as penetrate, thro' their ſubtilty or fineneſs of Parts; yet corrode not by their Acrimony.

EXPLANATION.

The Means of procuring them.

THIS *Axiom*, or the Canon it affords, is eaſier to underſtand than to practiſe: for 'tis plain, that whatever penetrates kindly, but at the ſame time has a ſtimulating Virtue or Pungency, (which is the Caſe of all acid and biting Things,) leave, wherever they paſs, ſome Impreſſion of Dryneſs, or Corroſion; ſo as to indurate the Juices, and vellicate the Parts: whereas, ſuch as penetrate by mere Subtilty, ſteal in and inſinuate themſelves, without Violence; whilſt they moiſten and bedew the Parts in their Paſſage. And ſome ſuch Remedies as theſe, we have deſcribed under the *fourth* and *ſeventh* of our *ten Operations*.

AXIOM XXII.

Aſſimilation is beſt perform'd upon the Ceſſation of the Local Motion.

EXPLANATION.

THIS *Axiom* ſtands ſufficiently explain'd by what is delivered under our *eighth Operation*.

AXIOM

AXIOM XXIII.

External Alimentation, at leaſt ſuch as is not perform'd by the Stomach, if it cou'd be procured, wou'd prove very ſerviceable in prolonging Life.

EXPLANATION.

A Method of external Alimentation.

WE ſee that every Thing perform'd by Nutrition, is perform'd by long Circuits; but much quicker by the way of imbibing a ſimilar Subſtance, as in the Caſe of Infuſions: a Method, therefore, of Alimentation from without, wou'd be extremely uſeful; the rather becauſe the digeſting Faculties fall off, and fail in Old-Age. Whence if there cou'd be any auxiliary ways of Nutrition contrived, by bathing, anointing, or by Glyſters; they might prove ſerviceable, by a proper Conjunction of ſome of them, which ſeparate wou'd be of leſs Significance.

AXIOM XXIV.

Where Concoction is weak, ſo as not to protrude the Aliment, the external Parts ſhou'd be excited; in order to attract the Aliment outwards.

EXPLANATION.

Concoction how to be ſtrengthen'd.

THE Senſe of this *Axiom* is not the ſame with that immediately foregoing; for 'tis one Thing to attract the Aliment inwards, and another to draw it from within outwards: tho they both agree, in ſupplying the weakneſs of the internal Concoctions another way.

AXIOM XXV.

All quick Renovation of the Body, is procured either by the Spirits, or by Malaxing.

EXPLANATION.

Quick Renovation how procured.

THE Body conſiſts of two Things; Spirits and tangible Parts; both which are but ſlowly reach'd by Nutrition: whilſt the ſhort way to the Spirits is by Vapours, and the Paſſions of the Mind; and to the Parts, by ſuppling and mollifying Applications. But we muſt well diſtinguiſh between Alimentation by external Means, and malaxing: for the Intention of malaxing is not to nouriſh the Parts; but only the better to prepare them for being nouriſh'd.

AXIOM

AXIOM XXVI.

Malaxing is perform'd by Subſtances ſimilar to the Body; Subſtances that inſinuate into it; and Subſtances that cloſe it up.

EXPLANATION.

Malaxing how to be perform-ed.

'TIS evident, that ſimilar Subſtances to the Body, are properly mollifying; whilſt ſuch as eaſily inſinuate, help others forward; and ſuch as cloſe up or conſtringe, help to keep in and prevent Perſpiration, which is a Motion oppoſite to Malaxing. This Operation, therefore, cannot be well perform'd at once; but ſhou'd be attempted in a Series and Method: (1.) By excluding the Liquor externally applied for the purpoſe, in the way of coating the Body over with ſome thick unctuous Matter: becauſe all extraneous and groſs Immerſion, as in common Bathing, does not well conſolidate the Body; but what is deſign'd to enter it, ſhou'd be ſubtile, and a kind of Vapour; according to the Obſervation deliver'd in our *ninth Operation.* (2.) By mollifying, thro' a Conſent of Subſtances of like kind: for Bodies open themſelves, and relax their Pores, when they come in Contact with Things very agreeable to them. (3.) By uſing proper inſinuating matters as Vehicles, that in ſome meaſure may convey and carry forwards the Subſtances of like Nature with the Body: Theſe Vehicles alſo being lightly impregnated with gentle Conſtringents, that at the ſame time may a little check and prevent Perſpiration. And, (4.) By following theſe Operations with a great Aſtriction, or ſhutting up of the Pores, by an emplaſtick Coating; and afterwards gradually by anointing; till the mollifying Matter acquires ſome degree of Solidity.

AXIOM XXVII.

A frequent renovation of the reparable Parts, renews alſo the Parts that are leſs reparable.

EXPLANATION.

The old Parts how to be re-new'd.

WE obſerved, in our general *Introduction* to this Hiſtory, that in the natural Progreſs of Death, the more reparable Parts periſh in the Embraces of the Parts leſs reparable; and that the utmoſt Efforts were to be uſed for repairing theſe leſs reparable Parts. Admoniſh'd, therefore, by the Obſervation of *Ariſtotle* upon Plants, where he ſays that the ſhooting out of new Branches cauſes alſo a renewal of the Trunk, by the Paſſage of the new Juices thro' it; we judge the Caſe might be the ſame, if the Blood and Fleſh of the human Body were frequently renewed; and that the Membranes and other Parts, even the Bones themſelves, tho leſs reparable in their

their own Nature, might be refreſh'd, recruited and renew'd; partly by a briſk Paſſage and Circulation of new Juices in them; and partly again by the new Clothing, of recent Fleſh and Blood, brought upon them.

AXIOM XXVIII.

That kind of Cooling, which does not paſs by the Stomach, is conducive to long Life.

EXPLANATION.

THE Reaſon is obvious; as not a temperate, but a powerful degree of Coolneſs, eſpecially in the Blood, is a principal Requiſite to long Life: which Coolneſs cannot be procured in the neceſſary degree, by any Thing taken at the Mouth; without Prejudice, and Deſtruction, to the Stomach and *Viſcera*. *The Cooling conducive to long Life.*

AXIOM XXIX.

This Complication, that both Conſumption and Repair are the Operations of Heat, is the greateſt Obſtacle to long Life.

EXPLANATION.

MOST great Works are prevented or deſtroy'd by complicated Natures; what proves ſerviceable in ſome Reſpects, proving prejudicial in others: ſo that a conſummate Judgment, and a diſcreet Practice, are here required. This we have, ſo far as the Subject allows, and our preſent Thoughts can reach, endeavoured after; and done our utmoſt to ſeparate the benign and favourable Heats from ſuch as are unkindly or hurtful; and given our Directions and Cautions with regard to both [q]. *The great Obſtacle to long Life.*

AXIOM XXX.

The Cure of Diſeaſes requires temporary Medicines; but long Life can only be expected from a Regimen and Diet.

EXPLANATION.

THOSE Things that happen by accident ceaſe upon removal of their Cauſes; but the Courſe of Nature is a continued Thing, which, like a rapid River, requires to be continually rowed againſt: whence to prolong Life, we muſt work regularly by a Regimen. *Regimens* are of two Kinds; *The Regimens required to prolong Life.*

(1.) *Stated*

[q] See above, *Operation* 2, 3, 9, &c.

(1.) *Stated*; or to be obſerved at certain times; and (2.) *Familiar*; which ſhou'd be brought into daily Uſe. But *ſtated Regimens*, or a ſeries of Remedies continued for a Seaſon, are the moſt powerful. For Things, of that Efficacy as to turn Nature back in her Courſe, muſt generally be ſtronger and productive of more ſudden Alterations, than thoſe that can, with ſafety, be brought into frequent and familiar Uſe. Our *Intentional Remedies* turn but upon three ſtated Regimens; *viz.* (1.) The opiate Regimen; (2.) The malaxing Regimen; and (3.) The diſcharging, and renovating Regimen. Among the moſt effectual Things preſcribed, in our familiar and daily Regimen, and which almoſt equal the force of ſtated Regimens; are (1.) Nitre and its Subſtitutes; (2.) The Government of the Paſſions, and regulating the kinds of Study; (3.) Methods of Cooling, that paſs not by the Stomach; (4.) Balmy Drinks; (5.) The impregnation of the Blood with a firm Subſtance, as that of Pearls or Woods; (6.) Proper Unguents to exclude the Air, and keep in the Spirits; (7.) Proper external Methods of heating, during the time of Aſſimilation, after Sleep; (8.) A cautious Uſe of ſuch Things as inflame the Spirits, and give them a ſharp conſuming Heat; for Example, Wines and Spices; and, (9.) A moderate and ſeaſonable Uſe of ſuch Things as give a robuſt Heat to the Spirits; for Example, Saffron, Creſſes, Garlick, Ellicampane, and compound Opiates.

AXIOM XXXI.

Flame is a momentary Subſtance; Air a fixed Subſtance: but the vital Spirits of Animals, is a middle Subſtance, betwixt both.

EXPLANATION.

The Relation betwixt Flame, Air, and vital Spirit.

THIS is a matter of deep Enquiry; and requires a larger Explanation than belongs to the preſent Subject. Let it be obſerved, however, that Flame is continually generating and dying: ſo as to exiſt only in Succeſſion. But Air is a permanent Body that does not periſh; for altho new Air be generated from aqueous Moiſture, yet the old Air ſtill remains: whence proceeds a Surcharge of Air[z]. The vital Spirit participates of both Natures; and is at once flamy and aerial. And accordingly its Pabulum or Fewel, are Oil and Air; the Oil being homogeneous with Flame, and the Air with Water: for Spirit is not fed, or nouriſhed by Oil alone, or by Water alone; but by both. And tho Air neither comports well with Flame, nor Oil with Water; yet they ſuit in Mixture or Compoſition. Again, Spirit has its ready and delicate Impreſſions from the Air; but its noble, powerful, and active Motions from Flame. So, likewiſe, the duration of Spirit is a compound Duration; not ſo momentary as that of Flame, nor yet ſo permanent as that of Air. It differs alſo ſo much the more from Flame, becauſe Flame is extinguiſh'd by Accident or by Contraries, and the ſurrounding

[z] See more of this in the enſuing *Hiſtory of Winds.*

rounding Bodies that deſtroy it; but Spirit, has no ſuch Cauſe nor Neceſſity of its Deſtruction. Laſtly, Spirit is repaired, or recruited, from the vivid and florid Blood of the fineſt Arteries; which creep along the Brain. But this Repair is made in its own peculiar manner; that comes not now to be conſidered.

AXIOM XXXII.

The vital Spirit is immediately deſtroy'd, upon being deprived of Motion, Coolneſs, or Aliment.

THESE three Things we call the *Avenues of Death*; and they are the proper and immediate Paſſions of the vital Spirit: for all the Organs of the principal Parts ſerve to perform theſe three Offices; and all the mortal Deſtructions of the Organs terminate in one or more of them: whence the reſt are but different Paths to Death; that end at laſt in theſe three grand Roads or Avenues. But the whole Fabrick and Structure of the Parts, is the Organ of the vital Spirit: and this Spirit itſelf is the Organ of the rational Soul; which is incorporeal and divine [f]. *The vital Spirit how deſtroy'd.*

[f] When the whole of this Enquiry ſhall be duly proſecuted, and completed, the Number of theſe *Axioms* may perhaps be conſiderably leſſen'd; or included under others more general, and a few ſure Rules diſcovered, for advantageouſly lengthening the preſent Period of Life: which we wiſh were not ſo generally looked upon as a Subject beyond the Reach of Men.

29 MR 64

A

DRAUGHT

For the PARTICULAR

HISTORY

OF THE

WIND:

WITH

A VIEW to bring it under the Power of

MAN;

And render it farther ſubſervient to

HUMAN USES.

A

DRAUGHT

For the PARTICULAR

HISTORY

OF THE

WIND:

WITH

A VIEW to bring it under the Power of

MAN:

And render it further subservient to

HUMAN USES.

PREFACE.

THE *following* History of Winds, *has ſcarce been more improved by the Moderns, than the preceding* History of Life and Death. *It ſhould ſeem as if few entred into the Nature and Deſign of theſe Pieces; ſo as to perceive how far they are carried; and how they may be farther advanced: and yet the Author appears to have given ample Directions for the Purpoſe. For tho he has himſelf gone great Lengths in theſe particular Hiſtories; yet they are rather intended as larger Examples, to teach Mankind the Method of Enquiring; than aim at being complete Enquiries themſelves* [a].

Numerous Obſervations have been made, and Journals kept of the Wind and the Weather. but even complete Sets of ſuch Obſervations will afford little Inſtruction; unleſs they are regularly tabled, and offered to the Mind in ſome tolerable order. Perhaps it would not be amiſs, if all the Obſervations of this kind were ranged under the following Heads; or, if theſe be inſufficient, under others of the ſame general kind; that their Doctrine might be drawn out, and a better Acquaintanee cultivated with the Subject. This would be making that Uſe of the preſent History *which the Author encourages, and plainly intended.*

INTRO-

[a] No Author has with greater Diligence and Exactneſs, I will not ſay enquired into, as taught others the way of enquiring into this Subject, than the great Lord *Verulam*, in his *Hiſtory of Winds*. And tho he there writes hiſtorically in many Particulars, I cannot determine whether they may ſafely be relied on. That Man had a vaſt and moſt extenſive Genius; equal, in my Opinion, to the full Diſcovery of all Nature; had he not been prevented by Civil Affairs. Yet, notwithſtanding his Poſt, and Employments, he has ſet on foot ſuch a *Method of Enquiries* as opens the wideſt Field to the Labours of others. His ſingle *Hiſtory of Winds* ſufficiently demonſtrates his incredible Capacity and Diligence; by the Clue and Direction whereof, infinite Remarks and Obſervations may be made, appertaining to this Subject. *Morhof. in Polyhiſt.* Tom. II. Cap. 23. *de Meteoris Aëreis, præcipue de Ventis*, pag. 381.

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INTRODUCTION.

THE *Winds* may be called the Wings of Mankind; by means whereof Men fly thro' the Sea, and maintain Traffick and Correſpondence with all the Parts of the Globe. They are alſo the Sweepers of Man's Habitation, the Earth; and at the ſame time bruſh and cleanſe the Air about it. On the other Hand, they ſometimes tear up and enrage the Sea, that wou'd otherwiſe remain quiet or undeſtructive; and have likewiſe other miſchievous Effects. Again, they produce ſtrong and violent Motions, without human Aſſiſtance; and thus, as Servants to Mankind, drive our Ships, and turn our Mills. They might alſo be applied to abundance of other uſeful Purpoſes; if Men wou'd exert their Diligence. The Nature of the Winds is uſually reckon'd an occult and ſecret Thing; and no wonder, whilſt the Nature and Power of the Air, which the Winds adminiſter to and wait upon; (as in the Language of the Poets, *Æolus* does on *Juno*) remain abſolutely unknown. They are not primary Creatures, or of the firſt ſix days Works, as to their Action; no more than the other Meteors; but were produced later in the Order of Creation.

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A DRAUGHT For the PARTICULAR HISTORY OF THE WIND, &c.

SECT. I.

The Table of Enquiry; or a Set of Heads for the Particular HISTORY *of the* WIND: *With the Conduct to be obſerved in the Proſecution.*

TITLE I.

The Names of the Winds.

DIRECTION.

1. UNDER this *Title* claſs the Winds, with regard to the Points of the Compaſs, or the Method obſerved at Sea; and aſſign them their ſeveral Names, antient or modern; ſo as to denote them fixedly and invariably.

2. *Winds* are either (1.) general, (2.) ſtated, (3.) ſerving [b], or (4.) free. We call thoſe *general Winds*, which never ceaſe to blow; thoſe *ſtated Winds*, which blow only at certain times; thoſe *ſerving Winds*, which blow oftenеſt; and thoſe *free Winds*, which blow indifferently at all times.

[b] See this Term explain'd under *Sect.* V. See alſo below, *Title* IV.

TITLE II.

General Winds.

DIRECTION.

3. Enquire whether there be any general Winds, and genuine Motions of the Air itſelf; and, if there be, in what Series of Motion, and in what Places they blow.

TITLE III.

Stated Winds.

DIRECTION.

4. Enquire what Winds are annual, and periodical, and in what Countries; and whether there be any Winds ſo preciſely ſtated, as to return regularly at certain Days and Hours, like the Tide of the Sea.

TITLE IV.

Serving Winds.

DIRECTION.

5. Enquire what Winds are waiting and familiar, or moſt conſtant to what Countries; at what times they blow in thoſe Countries; which in the Spring; which in the Summer; which in the Autumn; which in the Winter; which are Æquinoctial; which Solſtitial; which blow in the Morning; which at Noon; which in the Evening; and which at Night.

6. Again, enquire which are Sea-winds; and which blow from the Continent: and exactly obſerve the Differences between the Sea and Land-winds; as well thoſe that blow upon, as thoſe that blow from the Land and Sea.

TITLE V.

Free Winds.

DIRECTION.

7. Enquire whether Winds do not blow from all Points of the Heavens.

8. Winds do not differ much more in the Quarters they blow from, than in their Qualities; ſome being ſtrong, others gentle; ſome conſtant, others variable;

variable; ſome cold, others hot; ſome moiſt, and diſſolving, others dry, and conſtringing; ſome bringing Clouds, Rain, or Storms; others calming, and clearing the Air.

TITLE VI.

The different Qualities of Winds.

DIRECTION.

9. Enquire into and give the Hiſtory of the ſeveral Species, or abovemention'd Differences of Winds; and how they vary, as to Climates and Countries.

10. There are three local Origins of Winds; as being either, (1.) precipitated from above; (2.) riſing out of the Earth [c]; or (3.) produced in the Body of the Air itſelf.

TITLE VII.

The Local Origins of Winds.

DIRECTION.

11. Enquire after the three abovemention'd *Origins of Winds*; viz. (1.) Which of them deſcend from that call'd the middle Region of the Air; (2.) Which breathe from the Caverns of the Earth; whether they ruſh out boiſterous, and in a Body; or eſcape inſenſibly, by degrees, and afterwards roll together, as Rivulets collect into Rivers; (3.) And laſtly, which of them are generated indifferently, in all places, from the ſwelling and expanding of the contiguous Air.

12. But all the Productions of Winds are not Original; ſome being accidental, and proceeding from a Compreſſion, Percuſſion, and Repercuſſion of the Air.

TITLE VIII.

Accidental Generations, or Productions, of Winds.

DIRECTION.

13. Let enquiry be made into all the *accidental Generations of Winds*: tho theſe are not proper Generations of Winds; but rather increaſe and ſtrengthen them, than actually produce and excite them.

[c] And Sea.

14. And ſo much for the Winds that commonly obtain. But beſides theſe there are alſo certain *extraordinary Winds*, out of the common Courſe; ſuch as *fiery Winds*, *Whirlwinds*, *ſtormy Winds*, and *Tornados*; and theſe rage above Ground: there are likewiſe *ſubterraneous Winds*; ſome whereof are vaporous, ſultry, and mercurial; as in Mines: others ſulphureous and burſt out of Chaſms, caus'd by Earthquakes; or riſe hot from burning Mountains.

TITLE IX.

Extraordinary Winds, and ſudden Guſts.

DIRECTION.

15. Enquire into all uncommon, monſtrous and miraculous kinds of Winds.

16. From the particular Kinds of Winds, let the Enquiry paſs on to the Things which contribute to them; or are ſuppoſed to raiſe or lay them.

TITLE X.

The Things that contribute to Winds; and excite or appeaſe them.

DIRECTION.

17. The Enquiry ſhou'd not run out into Aſtrological Conſiderations about the Winds; nor Accuracies as to the Horoſcope of the Heavens: only the more manifeſt Obſervations of the Winds increaſing at the riſing of certain Stars, or the Eclipſing of the Luminaries, or the Conjunctions of the Planets, are not to be neglected: and remark how far they depend upon the Courſe of the Sun or Moon.

18. Enquire what the different kinds of Meteors contribute to the Winds; what Earthquakes contribute; what Showers; and what the meeting of Winds together: for theſe Things hang in a Chain, and draw in each other.

19. Enquire what a diverſity of Vapours and Exhalations contributes to Winds; and which Kinds of them are the more productive of Winds; and how far the nature of Winds depends upon theſe their Materials.

20. Enquire what thoſe Things contribute or make to Winds, which are found upon the Earth; what the Mountains contribute, and the diſſolving of Snow upon their Tops; what thoſe huge Maſſes of Ice which float, and are carried about in the Sea; what the difference of Soil, or any large Tracts of Land, as Marſhes, Sands, Woods, Champaigns, *&c.* Again, enquire what thoſe Things contribute which are performed by human Agency; as the burning of Heath, Fuzzes, *&c.* for the improvement of Land; the burning of Corn, or Villages, as in Wars; the Draining of marſhy Lands; the continual diſcharging of Cannon; the ringing of numerous

rous Bells together, as in great Cities, *&c.* 'Tis true, theſe are ſmaller Matters; but they may have ſome Effect.

21. Enquire into all the Ways of raiſing and laying the Winds; tho ſparingly as to any of the fabulous or ſuperſtitious Methods of doing it.

22. From hence let the Enquiry paſs on to the Limitations of the Winds, in Height, Extenſion, and Duration.

TITLE XI.

The Limitations of the Winds.

DIRECTION.

23. Let diligent Enquiry be made as to the Height, or Elevation, of the Winds; and if there be any Tops of Mountains where the Winds blow not; or if the Clouds ſometimes appear motionleſs and ſtationary, at the ſame time that the Winds are blowing ſtrong upon the Earth.

24. Enquire carefully into the Space which the Winds are found at once to poſſeſs; and within what Bounds they keep. For Example, ſuppoſe the South Wind ſhould blow in a certain Place; enquire whether the North Wind actually blow at the ſame time, ten Miles from that Place. And again, enquire into how narrow a Compaſs the Winds may be reduced, whilſt they run, as it were, thro' Pipes; which they ſeem to do in ſome kinds of Whirlwinds.

25. Enquire how long Winds uſually continue in their greateſt, mean, or ſmalleſt Duration, before they ſlacken, and as it were expire again; in what manner they riſe and begin; and in what manner they languiſh and ceaſe; whether of a ſudden, by degrees, or how.

26. From theſe Limits of the Winds, let the Enquiry proceed to their *Succeſſions*; either among themſelves, or with regard to Rain and Showers: for as all Winds and Rain lead up each other, it would be a pleaſure to know what Order they dance in.

TITLE XII.

The Succeſſions of the Winds.

DIRECTION.

27. Enquire whether there be any Rule, or certain Obſervation, as to the Order in which the Winds ſucceed one another; and whether it be conformable to the Sun's Motion, or otherwiſe; and however it be, to diſcover the Fact.

28. Enquire concerning the Succeſſion and Interchance of Winds and Rain: ſince it is uſual for Rain to allay the Winds; and for the Winds to keep up and diſſipate Rain.

29. Obſerve

29. Obſerve whether the Succeſſion of the Winds is renewed after a certain period of Years; and, if ſo, to find what that Period is.

30. From the Order of Succeſſion, let the Enquiry glide on to the Motions of the Winds. The Motions of the Winds branch themſelves into ſeven diſtinct Enquiries; three whereof are contained in the preceding Articles; and four remain hitherto untouched: for we have already mention'd, (1.) That Motion of them, which regards the Points of the Compaſs they blow from. (2.) Their Motion in the three Lines of Direction, upwards, downwards, and ſidewiſe. (3.) Their accidental Motion by Compreſſion; ſo that there remains, (4.) Their progreſſive Motion. (5.) Their undulatory Motion. (6.) Their impinging Motion. And, (7.) Their Motion in Organs, and Machines of human Invention.

TITLE XIII.

Different Motions of the Winds.

DIRECTION.

31. As Progreſſion always begins from a certain Point; let a very careful Enquiry be made into the Place of the primary Riſe, or, as it were, firſt Fountain of the Winds: for Winds reſemble Fame; and tho they tumultuate and bluſter every where, yet hide their Heads among the Clouds. Again, enquire into their Progreſs itſelf: for Example, if a ſtrong North Wind blew, upon a certain Day and Hour, at *York*; ſuppoſe it ſhould, two Days afterwards be found to blow at *London*, *&c.*

32. The Enquiry into the Undulation of the Winds muſt not be omitted. We call that Motion the Undulation of the Winds, wherein a Wind, for a ſmall Space, increaſes and ſlackens, or ſwells and falls again, like the Waves of the Sea; the Reciprocation whereof is known from the Sound they make in Buildings. And the Differences of this Undulation, or Riſing and Falling, betwixt the Air and Water, muſt be the more carefully obſerved; becauſe the Air and Winds have not that great Motion of Gravity, which is the chief Cauſe of the Undulation in Waters.

33. Let the Enquiry be carefully purſued, with regard to the impinging, or meeting of ſtrong Winds together; and blowing at the ſame time: as firſt, whether many original Winds may blow, and daſh againſt one another at once; and, if this happen, what Reciprocation it cauſes in the Motion: and again, what Condenſations and Alterations it produces in the Body of the Air.

34. Enquire whether ſome Winds do not blow at the ſame time above, that others blow below: for Clouds have been ſometimes obſerved to move in a contrary Direction to that of the Weather-cock; and ſometimes to be driven briſkly, whilſt there was a perfect Calm near the Surface of the Earth.

35. Let a very exact, careful, and particular Deſcription be made of the Motion of the Winds in the ſailing of Ships.

36. Deſcribe the Motion of the Winds in the Sails of Wind mills, the Flight of Hawks, and other Birds; and even in the common Phænomena and Diverſions; as the hoiſting of Flags and Streamers; the flying of Paper-Kites; fighting of Battles by the Wind, *&c.* And now, from the Motions, let the Enquiry paſs on to the Force and Powers of the Winds.

TITLE XIV.

The Powers of the Winds.

DIRECTION.

37. Enquire what Effects the Winds may have upon the Tides and Currents; as to keeping them out, driving them in, and cauſing them to overflow.

38. Enquire their Effect upon Vegetables and Inſects; as to their bringing in of Locuſts, Canker-worms, Mill-dews, Blights, Blaſts, *&c.* [d]

39. Enquire their Effects, as to purging and infecting the Air; the producing of Peſtilences, Diſeaſes, and Diſorders in Animals.

40. Enquire into their manner of conveying thoſe called *ſpiritual Species*; as Sounds, Emiſſions, Light [e], *&c.*

41. From theſe Powers of the Winds, let the Enquiry deſcend to the Prognoſticks of Winds; not only for the Uſe of Predictions, but on account of their leading up to Cauſes: for Prognoſticks either diſcover the Preparation of Things, before they come into Action; or their Beginnings, before they become manifeſt to the Senſes.

TITLE XV.

Preſages or Prognoſticks of Winds.

DIRECTION.

42. Let great Diligence be uſed to collect all the kinds of Prognoſtications of Winds, except thoſe of an aſtrological Nature; with regard to which we have above laid down our Directions [f]: otherwiſe they may be derived from Meteors, Waters, the Inſtinct of Animals, and many other things.

43. Laſtly, Let the whole *Enquiry* be cloſed by ſearching into Methods of imitating the Winds, for natural as well as artificial Purpoſes.

TITLE

[d] *Viz.* The ſcattering abroad, and ſowing the Seeds of Vegetables; in different Places, *&c.*

[e] See Dr. *Derham*'s Paper upon the Motion of Sounds, in the *Philoſophical Tranſactions.*

[f] § 17.

TITLE XVI.

Imitations of Winds.

DIRECTION.

44. Enquire into the Imitations of Winds in natural Subjects; ſuch are the Flatulencies in animal Bodies; and the Puffings, or Diſploſions of Subjects in chemical Diſtillations.

45. To conclude; Let Enquiry be made into *factitious* and *artificial Winds*, Gales, and Fannings; as by Bellows, Refrigeratories, or Cool-Rooms, *&c.*

46. Such are the *Heads* requiſite to a *particular Hiſtory of the Winds*; but we expect not that our preſent Stock of Experience ſhould be able to anſwer them all. However, as in Trials at Law, a good Lawyer knows how to put ſuch Queſtions as the Caſe requires; but knows not what the Witneſſes will anſwer: ſo we can proceed no otherwiſe in the *grand Cauſe betwixt Nature and Mankind*; and muſt leave Poſterity to ſee the Iſſue [g].

SECT. II.

The Hiſtory *of the* Appellations of the WINDS; *aſſigning to each a proper, fixed, and determinate Name; in proſecution of the firſt Article of the* Table of Enquiry.

The ancient Names of the Winds preſerved.

1. FOR the ſake of Clearneſs, and to help the Memory, we would enumerate and range the Winds, rather according to their natural Order and Degrees, than under the Names and Method aſſigned them by Antiquity. We ſhall, however, annex their ancient Names, that the ancient Authors from whom we have borrowed many Particulars (tho without truſting to them) may be the readier conſulted.

The general Diviſion of the Winds.

2. And for the *general Diviſion of the Winds*; let thoſe be termed, (1.) *Cardinal Winds*, which blow from the four Quarters, or Cardinal Points of the World; thoſe, (2.) *Semi-cardinal*, which blow in the middle between the former; and thoſe, (3.) *Median*, which blow any where betwixt the others: but of theſe *Median Winds*, let thoſe be called, (4.) the *Greater Medians*, that blow in the Quarters; and all the reſt be termed, (5.) the *Leſſer Median Winds* [h].

3. The

[g] Theſe Articles are not fully ſpoke to in the following Enquiry; and indeed the Whole, however great in itſelf, ſhould be eſteemed as little more than the Out-lines of a *Natural Hiſtory of the Wind*; that wants to be filled up by future Labour, Experiments, and Obſervations.

[h] See *Varenii Geographia*, Cap. 20. and 21.

3. The *particular Diviſion of the Winds* is expreſſed by the following *Table.* *Their particular Diviſion.*

A TABLE *ſhewing the particular Diviſions of the* WINDS; *with regard to the Mariner's Compaſs.*

I.

1. NORTH.	A Cardinal Point.
2. North and by Eaſt.	The North Wind one Point to the Eaſt.
3. North-North-Eaſt.	The North Wind two Points to the Eaſt. A greater Median Wind; anciently called *Aquilo.*
4. North-Eaſt and by North.	The North Wind three Points to the Eaſt; anciently called *Meſes.*
5. North-Eaſt.	A Semi-cardinal Wind; or North four Points to the Eaſt.
6. North-Eaſt and by Eaſt.	*Or*, North five Points to the Eaſt.
7. Eaſt-North-Eaſt.	*Or*, North ſix Points to the Eaſt. A greater Median Wind; anciently called *Cæcias.*
8. Eaſt and by North.	*Or*, North ſeven Points to the Eaſt.

II.

1. EAST.	A Cardinal Wind; anciently called *Subſolanus.*
2. Eaſt and by South.	*Or*, Eaſt one Point to the South.
3. Eaſt-South-Eaſt.	*Or*, Eaſt two Points to the South. A greater Median Wind; anciently called *Vulturnus.*
4. South-Eaſt and by Eaſt.	*Or*, Eaſt three Points to the South.
5. South-Eaſt.	A Semi-cardinal Wind. *Or*, Eaſt four Points to the South.
6. South-Eaſt and by South.	*Or*, Eaſt five Points to the South.
7. South-South-Eaſt.	*Or*, Eaſt ſix Points to the South. A greater Median Wind; anciently called *Phœnicias.*
8. South and by Eaſt.	*Or*, Eaſt ſeven Points to the South.

III.

1. SOUTH.	A Cardinal Wind; anciently called *Notus* or *Auſter.*
2. South and by Weſt.	*Or*, South one Point to the Weſt.

3. South-South-West. —— *Or*, South two Points to the West. A greater Median Wind; anciently called *Libonotus*.
4. South-West and by South. —— *Or*, South three Points to the West.
5. South-West. —— *Or*, South four Points to the West. A Semi-cardinal Wind; anciently called *Libs*.
6. South-West and by West. —— *Or*, South five Points to the West.
7. West-South-West. —— *Or*, South six Points to the West. A greater Median Wind; anciently called *Africus*.
8. West and by South. —— *Or*, South seven Points to the West.

IV.

1. WEST. —— A Cardinal Wind, anciently called *Favonius*.
2. West and by North. —— *Or*, West one Point to the North.
3. West-North-West. —— A greater Median Wind. *Or*, West two Points to the North; and anciently called *Corus*.
4. North-West and by West. —— *Or*, West three Points to the North.
5. North-West. —— A Semi-cardinal Wind. *Or*, West four Points to the North.
6. North-West and by North. —— *Or*, West five Points to the North; and anciently called *Thrascias*.
7. North-North-West. —— *Or*, West six Points to the North. A greater Median Wind; anciently called *Circius*.
8. North and by West. —— *Or*, West seven Points to the North.

4. There are, besides these, other ancient Names of Winds; as *Apeliotes*, *Argestes*, *Olympias*, *Sciron*, *Hellespontius*, *Iapyx*, &c. but we pay little regard to them; 'tis sufficient to have given fix'd Appellations to the several Winds in the regular Order and Division of the *Horizon*: for we lay no Stress upon the understanding of Authors; as Authors contain but very little to our Purpose.

SECT.

SECT. III.

Of Free *and* General WINDS; *with regard to the ſecond and fifth Articles of the* Table of Enquiry.

1. THERE is no Point of the Heavens, but a Wind may blow from it; ſo that if the Heavens were divided into as many Points as there are Degrees in the Horizon, there will, one time or other, be found Winds blowing from each [i]. *Winds may blow from all the Points of the Heavens.*

2. There are ſome whole Countries where it never rains, or at moſt very ſeldom; but none where the Winds do not blow; and that frequently. *Some Countries without Rain.*

3. There are few Phænomena obſerved of *General Winds*; and no wonder, as theſe Winds are principally found within the Tropicks, where chiefly lie the Places condemned by the Ancients for uninhabitable. But thoſe who ſail in the open Sea, between the Tropicks, obſerve a Wind, or Breeze, continually blowing from Eaſt to Weſt; which is not ſo gentle, but that partly by its own Motion, and partly by affecting the Current of the Sea, it renders it impoſſible for Ships to return towards *Peru*, the ſame way they came. *General Winds chiefly within the Tropicks.*

4. In our *European* Seas, there is obſerved (when the Heavens are clear and ſerene, and no particular Winds ſtirring) a certain gentle Breeze, breathing from the Eaſt, and following the Sun. *A Breeze following the Sun in the* European *Seas.*

5. 'Tis found by common Obſervation, that the higher Clouds generally move from Eaſt to Weſt; and this even at the ſame time when there is Calm, or a Wind blowing in a contrary Direction, near the Surface of the Earth. And if this prove not always the Caſe, the Reaſon may be owing to *particular Winds*, ſometimes blowing above; ſo as to diſturb, or over-power this *General Wind*. *The Motion of the higher Clouds.*

ADMONITION.

If there be any ſuch *general Wind*, proceeding from the Order of the Motion of the Heavens, it is not ſtrong enough to reſiſt the *particular Winds*. And ſuch a Wind becomes more manifeſt within the Tropicks, by reaſon of the larger Circles it there has to move in; and alſo high up, for the ſame reaſon; and to enjoy the freer Courſe. Therefore, whoever would endeavour to diſcover this Wind without the Tropicks, and near the Earth's Surface (where it breathes but ſmall and ſoft) let him make the Experiment in the open and free Air, in the greateſt Calms, and higheſt Places; and that with a very moveable Body; and towards the Evening; becauſe at this time the particular Eaſt Wind blows leſs. *Directions for diſcovering the general Winds out of the Tropicks.*

[i] That is, ſuppoſing, for Example, the Horizon divided into 360 Degrees; as all Circles are by Mathematicians.

PRECEPT.

Weather-cocks to be observed. Let a careful Obſervation be made of the Weather-cock, Vanes, Streamers, and the like, on the Tops of Steeples, high Edifices, Ships, *&c.* in order to determine whether, in the greateſt Calms, they do not always tend to the Weſt.

Indirect Phænomena.

Whence the Weſt Wind more beneficial than the Eaſt. 6. 'Tis matter of Obſervation, that the Eaſt Wind in *Europe* is a ſharp and drying Wind; but the Weſt Wind, on the contrary, moiſt and favourable. Does not this proceed from hence, that, upon a Suppoſition of the Air's Motion from Eaſt to Weſt, the Eaſt Wind, which goes alſo in that Direction, neceſſarily rarifies, and drives the Air before it, ſo as to make it more dry and predatory; whereas the Weſt Wind, which moves in a contrary Direction, condenſes, and turns the Air back upon itſelf; from whence it becomes leſs ſharp or cutting, and afterwards moiſtening?

Whether the Sea moves from Eaſt to Weſt. 7. Conſult the *Enquiry of the Motion of the Tides* [k], to diſcover whether the Waters move from Eaſt to Weſt: for if the Heavens, and the Waters, which are the Extremities of the Air, have this Motion; 'tis highly probable that the Air itſelf, which lies between them, participates of it likewiſe.

ADMONITIONS.

Indirect Phænomena, what. (1.) The two preceding *Phænomena* we call indirect; as not pointing out the thing immediately, but conſequentially: and this is a kind of Phænomena which we willingly admit and receive; in defect of a ſufficient Stock of direct ones.

Conjectures at the Cauſes of the conſtant Breeze within the Tropicks. (2.) 'Tis certain Fact, that there blows a conſtant, manifeſt Breeze between the Tropicks; but the *Cauſe* thereof is doubtful. It may be owing to this; that the Air, as we before obſerved, moves in the direction of the Heavens; but leſs perceptibly without the Tropicks, becauſe of the ſmaller Circles there. Another Reaſon may be this; that all Air is expanded by Heat; and, by this Expanſion, the contiguous Air is of neceſſity impell'd, ſo as to create that conſtant Breeze; whilſt the Sun holds on its Courſe: but this Expanſion muſt be more conſiderable within the Tropicks, where the Sun is hotteſt; and again, but ſmall without them, where 'tis colder. It might ſeem a *Crucial Inſtance* [l] for ſolving this Difficulty, were it but known, whether this Breeze continues by Night, or not; becauſe the Rotation of the Air continues by Night, tho the Heat of the Sun does not.

This Breeze ceaſes by Night. (3.) Now 'tis certain this Breeze comes not in the Night; but in the Morning, or ſome time after the Sun is up. Yet this Inſtance does not determine

[k] See the *Novum Organum*, Part II.
[l] See *Novum Organum*, Part II. Aph. XXXVI.

termine the Point; becauſe the nocturnal Condenſation of the Air, eſpecially in ſuch Places where the Day and Night are as different in Heat and Coldneſs, as they are equal in their Lengths, may check and confound this natural but gentle Motion [m].

(4.) If the Air participate of the Motion of the Heavens; it follows, not only that the Eaſt Wind coincides with, whilſt the Weſt Wind oppoſes, the Motion of the Air; but alſo, that the North Wind blows, as it were from above; and the South Wind as from below, in our Hemiſphere; where the South Pole is depreſſed, and the North Pole elevated above the Horizon. And this Obſervation was made by the Ancients, tho with uncertainty and obſcurity: but it excellently agrees with modern Experience; becauſe the conſtant Breeze we ſpeak of, which may be a Motion of the Air, is not due Eaſt, but North-eaſterly [n]. *The Conſequence, if the Air moves with the Heavens.*

SECT. IV.

Of Stated WINDS *with regard to the third Article of the* Table of Enquiry.

TRANSITION.

AS the Minds of Men ſeem to have been dark in the Enquiry about general Winds; ſo, in that of ſtated Winds they ſeem to have been giddy: for of the former they ſay nothing; and of the latter they talk very ramblingly. But this is the more pardonable, becauſe the thing itſelf is variable; ſince ſtated Winds change with the Place, ſo as not to blow the ſame, for inſtance, in *Egypt*, *Greece*, and *Italy*. *The Subject of ſtated Winds tread unſteddily.*

1. That there are *ſtated Winds* in ſome Place or other, may appear from the very Name; and again, from that other Appellation of *Eteſian*, or *Anniverſary Winds*. Eteſian *or anniverſary Winds.*

2. One *Cauſe* of the overflowing of the *Nile*, was antiently made the blowing of the *Eteſian*, or northerly Winds, at that time of the Year; ſo as to prevent the Courſe of the River into the Sea, and drive it backwards. *Overflowing of the* Nile *imputed to the* Eteſian *Winds.*

3. There are *Currents* found in the Sea, which can neither be attributed to the natural Motion of the Ocean, nor to the Declivity of more elevated Parts, nor to the Straitneſs of oppoſite Shores, nor to Promontories running out into the Sea; but are plainly governed by *ſtated Winds*. *Currents owing to ſtated Winds.*

4. Thoſe who will not allow *Columbus* to have conceived ſo certain and fixed an Opinion of the *Weſt-Indies*, from the Relation of a *Spaniſh* Pilot, yet think it trifling for him to have formed it upon the obſcure Traces and Rumours *The Diſcovery of the* Weſt-Indies *ſuppoſed owing to theſe Winds.*

[m] See the *Appendix to Dr.* Jurin's *Edition of* Varenius, *Pag.* 31 — 39.

[n] Some Additions might be made to this Section, from Mr. *Bohun's Diſcourſe concerning the Origin and Properties of Winds.* Printed at *Oxford* An. 1671. See *Pag.* 68—100, *&c.*

Rumours of Antiquity, pretend he conjectured there muſt be a *Continent to the Weſt*, from the *ſtated Winds* on the Coaſt of *Portugal*. And tho this be an uncertain and ſomewhat improbable thing; ſince the Courſe of thoſe Winds can ſcarce be kept for ſo great a Diſtance; yet it derives Honour to the preſent Enquiry, if the *Diſcovery of a new World* be owing to one *Axiom*, or *Obſervation*, of the many it contains.

Stated Winds from ſnowy Mountains. And marſhy Grounds.

5. Wherever there are high Mountains covered with Snow; *ſtated Winds* blow from that Quarter at the time the Snow diſſolves.

6. We ſuſpect alſo, that *ſtated Winds* may blow from great Tracts of Marſh-land, overflow'd in the Winter; and this about ſuch time as the Sun begins to dry up the Water: but of this we have no ſettled Obſervation.

From periodical Vapours.

7. Wherever Vapours are generated in great abundance, and this at certain Times; *ſtated Winds* are there found to riſe, at thoſe Times.

Stated Winds from far.

8. When *ſtated Winds* blow in any Place, and their *Cauſe* be not found near at hand; ſuch ſtated Winds muſt be deemed foreign, and to come from far.

Do not blow in the Night.

9. 'Tis obſerved, that *ſtated Winds* blow not in the Night; but riſe about three Hours after the Sun is up: whence they ſeem to be ſo weakened, or, as it were, tired with a long Journey, that they can ſcarce break thro' the nocturnal Condenſation of the Air; but are again quickened and recover'd a little after Sun-riſing.

Generally weak.

10. All *ſtated Winds* are weak, except they blow from Places near at hand; and ever yield to the Winds that riſe of a ſudden.

11. There are many *ſtated Winds* which we do not perceive, or obſerve, by reaſon of their Weakneſs; as being ſuppreſſed, or over-powered, by the free Winds: and are therefore ſcarce found in the Winter, when the free Winds are moſt abroad; but rather towards the Summer, when ſuch wandering Winds are ſtiller.

The ſtated Winds of Europe.

12. In *Europe*, the principal *ſtated Winds* are, (1.) Northerly Winds, from the Solſtice; and theſe both precede and follow the Riſe of the Dog-ſtar; (2.) the WeſtWinds, from the autumnal Equinox; and, (3.) the Eaſt Winds, from the vernal: but for the Winter Solſtice, 'tis not much to be regarded, becauſe of the Changes and Alterations whereto the Winter is ſubject.

The Bird-Winds.

13. The *Bird-Winds*, (ſo called on account of their bringing Birds from cold Regions beyond the Sea, into warmer) have no relation to *ſtated Winds*; becauſe they often deceive in point of Time: but let them blow ſooner or later, the Birds wait for them; and frequently, after theſe Winds begin to blow, they again fall off, and fail the Birds, which thence drop into the Sea, and ſometimes upon Ships.

The Returns of the Winds not known.

14. There is hitherto diſcovered no way of predicting the Return of the Winds, to a certain Day and Hour; as there is in the Caſe of the Tides: ſome Writers indeed, now and then fix a Day for their return; but they do this rather from conjecture than certain Obſervations*.

SECT.

* Conſult *Bohun's Diſcourſe of Winds*.

SECT. V.

Of Serving WINDS; *with regard to the fourth Article of the* Table of Enquiry.

TRANSITION.

THIS Term of *Serving Winds* we have coined, to the end that Obſervations about them may not be loſt; or confounded along with others. Our meaning is this. Divide, for Example, the Year into three, four, or five Parts, in whatever Country; and if any Wind blow there for two, three, or four of theſe Parts; and a contrary Wind but for one Part; then the Wind which blows oftenеſt we call the *Serving* or *Waiting Wind* of that Country. And the like may be underſtood of the Weather. *Serving Winds what.*

1. The South and North Winds are the *Serving Winds* of the World; for theſe, and their Diviſions, blow more frequently over all the Globe, than the Eaſt and Weſt Winds, with their Diviſions. *South and North Winds the Serving Winds of the Globe.*

2. All the free Winds wait more upon the Winter than the Summer; but principally upon the Autumn and the Spring. *The free Winds attend, chiefly, the Spring and Autumn.*

3. All the free Winds wait more upon the Regions without the Tropicks and polar Circles, than within them: for they generally blow little in the Torrid and Frigid Zones; but frequently in the Temperate. *And without the Tropicks.*

4. So, likewiſe, all the free Winds, eſpecially the ſtrongeſt of them, blow oftener, and more violently; in the Morning and Evening, than at Noon and Night. *Strongeſt at Morning and Evening.*

5. The free Winds are obſerved to blow more frequent in ſuch Countries as lie hollow and cavernous, than in ſuch as are more firm and ſolid [p]. *Moſt frequent in cavernous Countries.*

ADMONITION.

Men have taken very little Pains to obſerve theſe *Serving Winds* in particular Countries; but if the Thing were done, it would be uſeful in many reſpects. Upon aſking a certain intelligent Merchant, who was Maſter of a Colony in *Newfoundland*, and had wintered there himſelf, the Reaſon why that Country was reputed ſo extremely cold, beyond what the Climate promiſed? he replied, the Fact was not altogether ſo true as reported; but that the Cauſes were two: the one, that the huge Maſſes of Ice brought down by the Currents from the frozen Sea, paſſed along the Shores; the other, which he judged abundantly the more conſiderable, was, that the Weſt Wind there, blows for a much greater part of the Year than the Eaſt; as it does alſo, *ſays he*, in *England*; but at the Fiſhery it blows cold from *The Coldneſs of* Newfoundland, *whence.*

[p] See hereafter, *Sect.* VII. 9, 10, &c.

from the Continent; whereas, in *England*, it blows warm from the Sea: but, *continues he*, if the East Wind blew so often, and so long in *England* as the West Wind does at the Fishery; the Cold in *England* would be much more intense, and equal, perhaps, to what it is there[q].

The West Wind attends the Afternoon.

6. The West Wind is the Attendant of the Afternoon; as generally blowing whilst the Sun descends from the Meridian: but this the East Wind does much seldomer.

The South, the Night.

7. The South Wind waits upon the Night; as often rising and blowing strongly at that time: but the North Wind tends more upon the Day.

The Serving Winds at Sea, differ from those of the Continent.

8. There are many and great Differences between the *Serving Winds* of the Sea, and those of the Continent; especially in the Particular which is said to have given *Columbus* the Hint for discovering the *West-Indies*; viz. that the Sea-Winds are not stated, as the Land-Winds generally are. For as the Sea abounds with Vapours, which are in a manner present indifferently; Winds are also there generated indifferently, and blow every way, with great inconstancy; as having no certain *Origins* or *Fountains*[r]: whilst the Earth is very unequally provided of the Matter of Winds; some Parts of its Surface being well fitted for producing and increasing them; but others not; whence they here commonly blow from the Place of their Origin; and thence obtain their Direction.

The Waiting Winds at Peru.

9. *Acosta* seems to differ from himself, when he says, in one place, that the South Winds blow during almost the whole Year in *Peru*, and along the Coasts of the *South-Sea*; but, in another place, that the Sea-Winds principally blow along those Shores: for the South Wind there, is a Land Wind; so likewise are the North and the East; whilst only the West is a Sea-Wind in those Parts. He seems exactest in the first case; *viz.* that the South is a *Waiting Wind*, and there familiar; unless perhaps from the Name of the *South-Sea*, he either conceived wrong, or expressed himself improperly, and by South meant the West Wind; because this blows from the *South-Sea*. But the Sea called the *South-Sea*, is not properly a South Sea; but, as it were, a second *Western Ocean*, stretching in a like Direction with the *Atlantick*.

Sea Winds purer than Land Winds.

10. Sea-Winds are doubtless moister than Land-Winds, yet purer; and such as easier and more equably mix with a pure Air: for Land-Winds are ill compounded and smoaky. Nor let it be objected, that Sea-Winds are grosser, because of the Saltness of the Sea; for the terrestrial Nature of the Salt does not suffer it to rise in Vapour.

How rendered warm or cold.

11. Sea-Winds are warm or cold, according as they participate of the two Qualities just now mentioned; *viz.* Humidity and Purity. By their Humidity they mitigate the Force of Cold; (for Dryness increases both Cold and Heat:) and again, they cool by their Purity; whence, without the Tropicks they are warm, but within them cold.

12.

[q] See Mr. *Boyle's History of Cold*, passim.
[r] See hereafter, *Sect.* VII.

12. We judge that the Sea Winds are every where the *Serving Winds* of particular Countries; eſpecially on the Coaſts: as Winds oftneſt blow from the Sea, by reaſon of the much greater ſtock of Matter thence ſupplied to them than by the Land; unleſs any *Stated Wind* ſhould thro' ſome particular Cauſe, chance to blow from the Land. And let not *Stated Winds* be confounded with *Waiting Winds*; for *Waiting Winds* ever blow oftneſt; but Stated Winds generally ſeldom; tho this they both have in common with other Winds, that they blow from the Place where they are generated. *Sea Winds the Serving Winds of Countries.*

13. Sea Winds are generally ſtronger than Land Winds; yet, when they ceaſe, the Calm is greater out at Sea than near the Shore: inſomuch that Sailors ſometimes chuſe to keep within the Winds of the Coaſt, rather than venture out; to avoid being becalmed. *Sea Winds ſtronger than Land Winds.*

14. *Recurrent Winds* blow from the Sea to the Shore; that is, ſuch Winds as after having gone forwards for a while, turn back ſuddenly. And this ſeems owing to a certain Refraction, and Inequality, between the Breezes of the Sea, and thoſe of the Land; for all Inequality of the Air is the beginning of a Wind. But theſe Recurrent and Variable Winds chiefly happen in Bays of the Sea. *Recurrent Winds, what and whence.*

15. There are Breezes generally found about all great Waters; eſpecially in the Morning: but more about Rivers than at Sea, by reaſon of the difference betwixt the Breezes of the Land, and thoſe of the Water. *Breezes found about Waters.*

16. Trees growing near the Sea-ſhore, are generally obſerved to bend away from the Sea Breezes; as if they had ſome Antipathy thereto: but this ſeems owing to the Humidity and Denſity of ſuch Breezes; which renders them more ponderous and powerful. *Why Trees bend from the Sea Breezes.*

SECT. VI.

Of the Qualities *and* Powers *of the* WINDS; *in proſecution of the ſixth and fourteenth Articles of the* Table of Enquiry.

TRANSITION.

MEN have ſhewn little Diligence, and Curioſity, in obſerving the Qualities, and Powers, of the Winds. We ſhall here only ſelect ſuch Particulars relating thereto, as are more ſtable and certain; leaving the lighter to the Mercy of the Winds.

1. The South-Wind, with us, brings Rain; and the North, fair Weather. The former gathering and foſtering the Clouds; the latter diſſipating and diſperſing them. Whence the Poets, when they deſcribe the Deluge, feign the North Wind at that time impriſon'd; and the South-Wind ſent out with a very extenſive Commiſſion. *The South Wind rainy.*

The West Wind favourable.

2. The West Wind is esteemed the Wind of the *Golden Age*; the Companion of perpetual Spring; and the Cherisher of Flowers.

The Paracelsists *reject the East Wind.*

3. The School of *Paracelsus*, seeking a Place for their *three Principles* in the Temple of *Juno*, that is, the Air, have nicht the South, the North, and the West; but excluded the East [f].

The East Wind accounted pernicious.

4. In *England*, we take the East for a pernicious Wind: whence our common Saying, *East is neither good for Man nor Beast.*

The more essential Differences of the Winds.

5. The South Wind blows after the Sun has been present; but the North Wind, after the Sun has been absent in our Hemisphere: the East Wind, in the same Direction with the Air's Motion; but the West Wind always contrary thereto: the West Wind, from the Sea; the East, generally, from the Continent, in *Europe* and the western Parts of *Asia*. And these are the more essential Differences of the Winds; upon which most of their Powers and Qualities depend.

The South Wind less stated than the North.

6. The South Wind is less anniversary, and stated, than the North; as also more variable and free: and when become stated, 'tis so gentle as to be scarce perceptible.

The South Wind blows lower than the North.

7. The South Wind blows lower, and more laterally; but the North Wind higher, and proceeds from above. This we mean not of the Elevation and Depression of the Pole above-mentioned; but that the South Wind has its Origin generally nearer the Earth, and the North Wind farther up from it.

The South a fair Wind, in Africa.

8. Tho the South Wind brings Rain with us, yet it brings fair Weather in *Africa*, and causes great Heats; *Africa*, however, is tolerably wholsome: but if the South Wind, with us, continue blowing fair Weather, without Rain, for a considerable time, it proves very pestilential.

The South and West Winds, whence rainy.

9. The South and West Winds generate no Vapours; but only blow from those Quarters where the greatest Quantity of Vapours is collected by the Increase of the Sun's Heat, which raises Vapours; and therefore these are rainy Winds: but if they proceed from dry Places, that are free from Vapours, they blow fair Weather; tho along with their Purity they are sometimes sultry.

The Agreement betwixt the South and West; and North and East Winds.

10. The South and West Winds, with us in *England*, seem Confederates; being both of them warm and moist: on the other hand, the North and East Winds seem related; as both of them are cold and dry.

11. The North and South Winds blow oftener, as we touch'd above, than the East and West; because of the great Inequality of Vapours in the North and South Parts, occasioned there by the absence and presence of the Sun, which is, as it were, neutral or indifferent to the East and West.

The South and North Wind from the Sea.

12. The South Wind from the Sea is very wholsome; but more unhealthy from the Continent: on the contrary, the North Wind from the Sea is to be suspected; but from the Land it is wholsome. Again, the South Wind

[f] *Tincturis liquidum qui* Mercurialibus Austrum,
Divitis & Zephyri rorantes Sulphure *venas,*
Et Boream *tristi rigidum* Sale. ——

Wind blowing from the Sea is very beneficial to Fruits and Plants; driving away Mildews, Blaſts and the like, from them.

13. A gentle South Wind does not greatly collect Clouds; but often proves ſerene; eſpecially if it be of ſhort continuance: but if it blow rough, or long, it cauſes a cloudy Sky, and brings on Rain; tho it does this rather when it ceaſes or begins to fall, than when it firſt riſes, or continues in its ſtrength. *A South Wind ſerene.*

14. The South Wind, both in riſing and falling, generally cauſes a change of Weather; as from ſerene to cloudy; or from hot to cold: on the contrary, the North Wind often riſes and falls again, without altering the former ſtate of the Weather. *Cauſes change of Weather.*

15. After Froſts, or long continued Snows, ſcarce any other Wind blows beſides the South; or if a Concoction were now made of the frozen Matters, which thus reſolve: yet Rain does not always follow hereupon; for there are ſome ſerene Thaws. *Blows after Froſt.*

16. The South Wind riſes oftener, and blows ſtronger, by night than by day; eſpecially in winter Nights: but the North Wind, if contrary to its cuſtom, it ſhould riſe by night, ſeldom continues above three Days. *The South Wind ſtrongeſt by Night.*

17. Greater Waves roll to the Shore when the South Wind, than when the North Wind blows; tho they were both to blow with equal Force, or even the South Wind weakeſt[1]. *North Winds make largeſt Waves.*

18. When the South Wind blows, the Sea appears blue, or more bright; but when the North Wind blows, it appears blacker and darker. *Effects of the South and North Wind, on the appearance of the Sea.*

19. When the Air grows warm of a ſudden, it ſometimes denotes Rain; and, on the contrary, a cold Gale ſometimes does the ſame: but this follows according to the Nature of the Wind; for if the Air grow warm with a South or Eaſt Wind, it foretels Rain at hand; and ſo likewiſe, when it grows cold with a North or Weſt Wind. *Rain how foretold.*

20. The South Wind generally blows by itſelf, and unattended; but the North Wind, eſpecially that which is ſix Points to the Eaſt, and the Weſt two Points to the North, are often attended with other different and contrary Winds; whence they are reſiſted, and rendered tumultuary. *The tumultuary Winds.*

21. The North Wind is to be avoided in the Sowing of Seed; and the South Wind in the Buſineſs of inoculating and engrafting. *North Winds pernicious in Husbandry.*

22. The Leaves of Trees ſooneſt fall off on the South ſide; but Vines throw out their Shoots to the South, and ſcarce have any other Tendency. *Trees ſooneſt ſhed on the South.*

23. *Pliny* obſerves, that in wide Paſture-grounds, Shepherds ſhould drive their Flocks to the North ſide; that they may feed up to the South; becauſe feeding againſt the North gives them Lameneſs, blear-Eyes, and the Scouring. He adds, that the North Wind debilitates them for Generation; ſo that if they were to copulate with this Wind blowing in their Faces, they would generally produce Ewe-lambs: but in this, *Pliny*, acting only as a Tranſcriber, is not very conſiſtent. *Sheep to reſpect the South Wind.*

24. There are three principal Times when Winds prove hurtful to growing Corn; *viz.* (1.) in the opening of the Bud; (2.) the going off the Bloom; *When Winds damage the Corn.*

[1] How is this certainly known?

Bloom; and, (3.) near the time of ripening. In the latter caſe they empty the Ear, or blow out the Grain; and in the former two, either ſtrike off the Flower, or blaſt it in the Stem.

The Differences of the South and North Wind as to Health.

25. With the South Wind the Breath of Men ſmells ſtronger [u], Animals loſe of their Appetite, peſtilential Diſtempers are more frequent, Colds common, and the Bodies of Men more indiſpoſed and heavy: but with the North Wind Men are more briſk, healthy, and better in Appetite. The North Wind, however, proves prejudicial to ſuch as are troubled with the Phthiſick, Coughs, the Gout, or any ſharp Humour.

The Difference betwixt the Eaſt and Weſt Wind.

26. The Eaſt Wind is drying, predatory, and deſtructive; but the Weſt Wind moiſt, moderate, and cheriſhing.

Eaſt Winds deſtructive in the Spring.

27. The Eaſt Wind, blowing when the Spring is advanced, proves deſtructive to Fruits; by bringing in Caterpillars and other Worms; ſo as ſcarce to ſpare the Leaves; nor is it friendly to Corn: the Weſt Wind, on the contrary, is very favourable and friendly to Herbs, Flowers, and all the vegetable Tribe. The Eaſt Wind likewiſe, is ſomewhat favourable about the autumnal Equinox.

The Weſt Winds more boiſterous than the Eaſt.

28. The Weſt Winds are more boiſterous, and ruffle and bend the Trees more than thoſe from the Eaſt.

Rain with an Eaſt Wind.

29. A rainy Seaſon beginning with an Eaſt Wind, continues longer than that which begins with a Weſt Wind; and generally laſts a whole Day.

The more conſtant and changeable Winds.

30. The Eaſt and North Winds, after once they begin to blow, are more conſtant and fixed; but the South and Weſt Winds, more variable.

Viſion and Hearing increaſed by Winds.

31. With a ſtrong Eaſt Wind all viſible Objects appear larger; but with a ſtrong Weſt Wind Sounds are more audible, and reach to a greater diſtance.

The Eaſt-North-Eaſt Wind cloudy.

32. The Eaſt-North-Eaſt Wind, *viz.* ſix Points to the North, collects Clouds; inſomuch that this Wind became proverbial, among the *Greeks*, for a Cloud-gatherer; whence they compared Uſurers to it, who, by letting out Money fetch back more [v]. 'Tis a violent but wide-ſpreading Wind; ſo that it cannot drive away the Clouds quick enough to prevent their reſiſting, and forcing back upon it; which is the caſe alſo in large Conflagrations, that make head and prevail againſt the Winds.

The Cardinal Winds not ſtormy.

33. The Cardinal Winds, as alſo the Semi-cardinal, are not ſo ſtrong as the Median.

The calm and tempeſtuous Winds.

34. The Median Winds from North to North-Eaſt, are more ſerene; but from North-Eaſt to Eaſt more ſtormy. So likewiſe from Eaſt to South-Eaſt, they are more ſerene; but from South-Eaſt to South, more ſtormy. So again, from South to South-Weſt, more ſerene; and from South-Weſt to Weſt, more ſtormy. And ſo, laſtly, from Weſt to North-Weſt, more ſerene; but from North-Weſt to Weſt, more ſtormy. So that, proceeding according to the Order of the Heavens, the Median Winds of the former Semi-

[u] A ſtrong North, or North-eaſterly Wind, has been found to have nearly the ſame Effects on ſome tender Bodies, as Mercury; ſo as to occaſion a fetid Breath, looſen the Teeth, cauſe a Spitting, *&c.* And this has been more particularly obſerved ſome Days or Weeks after the taking of mercurial Phyſick.

[v] *Ceſſam Nubes ad ſe trahere.*

Semi-cardinal, are always more diſpoſed to be calm; and thoſe of the latter to be tempeſtuous [w].

35. Thunder, Lightning, and Storms happen when cold Winds blow; and ſuch as participate of the North; *viz.* the Weſt-North-Weſt, North and by Weſt, North-North-Weſt, North-Eaſt and by North, and the Eaſt-North-Eaſt. And hence Thunder is often accompanied with Hail. *The ſtormy Winds.*

36. Snowy Winds alſo come from the North; but theſe are ſuch Median Winds as are not ſtormy: for Example, the North-North-Weſt; and the North-Eaſt and by Eaſt. *Snowy Winds.*

37. Winds obtain their Nature and Properties five ſeveral ways; *viz.* (1.) from the abſence or preſence of the Sun; (2.) an Agreement or Diſagreement with the natural Motion of the Air; (3.) the Difference of the Matters whereof they are formed; as whether that of the Sea, Snow, Lakes, *&c.* (4.) the Impregnation of the Countries thro' which they paſs; and, (5.) their local Origins; whether on high; under the Earth; or in the middle Region; all which will be better explained in the following *Sections*. *Whence the Properties of Winds.*

38. All the Winds have a greater Power of drying, even than the Sun itſelf; becauſe the Sun raiſes Vapours, but does not diſſipate them, unleſs it beats very hot: whereas the Wind both raiſes them, and carries them off. But of all the Winds, the South has leaſt of this Effect; for Stones and Wood-work are obſerved to ſweat more with a gentle South Wind, than in a Calm. *Drying Winds.*

39. *March* Winds are much more drying than Summer Winds; inſomuch that the Makers of muſical Inſtruments wait the return of *March* Winds, for drying the Matter of their Inſtruments; and rendring it porous and ſonorous. *March Winds.*

40. All kinds of Winds purge the Air, and preſerve it from Corruption; inſomuch that the moſt windy Years are the moſt wholeſome. *Windy Years wholeſome.*

41. The Sun has the Fate of Princes, whoſe Governours of remote Provinces, frequently have more ſubmiſſive and obſequious Subjects than the Prince himſelf. Certainly the Winds, which have their Power and Origin from the Sun, govern and influence the Temperatures of Countries, and the Diſpoſition of the Air, as much or more than the Sun itſelf. Whence *Peru* is nearly as temperate, and its Air as mild, as in *Europe*; becauſe, by lying near the Sea, and having very large Rivers, and exceeding great and high Mountains covered with Snow, it receives a great Supply of Winds and Breezes. *The Power of the Winds in the Temperature of particular Countries.*

42. 'Tis no wonder that the Winds ſhould have that Force we obſerve of them, ſince violent Winds are like Inundations, Torrents, and huge Waves of the Air; and yet, if carefully attended to, their Power does not ſeem very extraordinary. Their violent Effects are, ſuch as the blowing down of Trees, which, being over-loaded with their own Tops, afford a kind of Sails for their own ſubverſion. So likewiſe they may overturn Houſes, that are ſlightly built; but for ſolid Buildings, they overturn them not; unleſs attended *The Strength of the Winds.*

[w] See the *Table of the Diviſions of the Winds*, Sect. II. whence this will appear more diſtinctly than it can well be expreſſed.

tended with Earthquakes. Sometimes alſo, they ſweep down whole Magazines of Snow from the Mountains, and almoſt bury the Vallies with it; an Accident that befel *Solyman* in the *Sultanian Plains*. Sometimes likewiſe they cauſe great Inundations of Water.

43. The Winds ſometimes blow whole Rivers out of their Channels, and leave their Bottoms bare; for if a ſtrong Wind ſhould, after a great Drought, continue blowing ſeveral Days, in the Direction of the Current, ſo as by tearing down the Water, to drive it into the Sea, and keep the Sea-Water from coming in, the River muſt neceſſarily become dry in many Places.

ADMONITIONS.

Obſervations change with the Poles.

(1.) When the *Poles* are changed, the Obſervations alſo, as to North and South, muſt change: for as the abſence and preſence of the Sun is here the Cauſe; this varies according as the North or South Pole is elevated. But it may be an invariable thing, that there is more Sea towards the South, and more Land towards the North; which alſo contributes much to the difference of the Winds.

The Uncertainty of the Subject.

(2.) Winds are generated a thouſand ways, as we ſhall ſee preſently; whence 'tis not eaſy to fix Obſervations in a Thing of ſo much uncertainty: but ſuch as we lay down, will doubtleſs generally hold good.

SECT. VII.

The HISTORY *of the* Local Origins of WINDS; *in proſecution of the ſeventh Article of the* Table of Enquiry.

TRANSITION.

Difficult to fix the Origin of Winds.

'TIS a difficult Enquiry, to ſettle the *Local Origin of the Winds*; ſince *whence they come, and whither they go*, is, even in Scripture, remarked for a ſecret thing. And this we ſpeak not as to the Fountains of particular Winds (of which hereafter;) but of the Wombs of the Winds in general. Some derive them from on high; ſome ſearch for them in the Deep; but there are few who ſeek them in the Middle; where they are moſt frequently generated. And this is the manner of Men, to paſs over what lies before their Feet, and look out for Obſcurities. Thus much is certain, that Winds are either Natives, or Strangers, and as it were Traders in Vapours; importing them collected into Clouds, and exporting them again to and from different Countries; whence Winds are produced as by Traffick and Exchange. But our preſent Enquiry is about native Winds; for thoſe which are foreign in ſome Parts, are Natives in others. There are then three local Origins hereof; *viz.* (1.) as they breathe out, or ſpring from

from the Earth; (2.) as they are thrown down from on high; and, (3.) as they are made up here in the Body of the Air. Thoſe thrown down from above, are generated two ways; being either precipitated before they are formed into Clouds; or afterwards, when the Clouds are rarified and diſperſed. We now proceed to their Hiſtory.

The poetical Notion of the Origin of Winds.

1. The Poets fable, that the Kingdom of *Æolus* was ſeated in Dens and Caverns under the Earth; where the Winds were impriſoned, and ſometimes let out.

The Notion of ſome ſcriptural Philoſophers.

2. Certain philoſophical Divines dwell upon theſe Words of Scripture: *Who brings forth the Winds out of his Treaſures.* As if the Winds proceeded from certain ſubterraneal Repoſitories, or Magazines. But nothing can be built upon this; for the Scripture likewiſe ſpeaks of the *Treaſures of Snow and Hail*; which, no one doubts, are generated above.

Air in the Bowels of the Earth.

3. There is, doubtleſs, a large Quantity of Air contained in the Bowels of the Earth; and this probably may gradually breathe from thence; and ſometimes upon particular Cauſes ruſh out in a Body.

An Indirect Phænomenon.

That Air may burſt out of the Earth.

In great Droughts and the midſt of Summer, when the Earth cracks, large Quantities of Water are frequently obſerved to burſt out in dry and ſandy Places: and if Water, which is a groſs Body, ſometimes does this; 'tis probable, that the ſubtile and rarified Body of Air may do it oftener.

Winds generated like Rivers.

4. When Air breathes out of the Earth gradually, and in ſmall Parcels, 'tis little perceived, at firſt; but when many of theſe ſmall Eruptions come together, they make a Wind; as a River is formed of Springs. And this ſeems to be the Caſe; becauſe the Antients have obſerved, that many Winds, at their firſt Riſe, and in the Places whence they riſe, firſt blow weak; but afterwards grow ſtronger, in their Progreſs; exactly after the manner of Rivers.

Subterraneous Winds.

5. There are ſome Places found in the Sea, and alſo ſome Lakes, which ſwell very conſiderably, tho no Winds are there found to blow; whence this ſhould ſeem owing to ſome ſubterraneous Blaſts.

Swellings of the Sea more frequent than Earthquakes.

6. A great Quantity or Force of ſubterraneous Spirit or Vapour, is neceſſary to ſhake or cleave the Earth; but a leſs will ſerve to raiſe the Water: and therefore Earthquakes ſeldom happen; but Swellings and Riſings of the Waters frequently.

7. 'Tis likewiſe a common Obſervation, that Waters ſwell and riſe a little before Storms.

8. The weak ſubterraneous Spirit, or Vapour, that eſcapes in ſmall Parcels, is not perceived upon the Earth till it gathers into a Wind; becauſe of the Poroſity of the Earth: but when it gets out from under the Waters, 'tis preſently

preſently perceived, from the Swelling of the Waters, by reaſon of their Continuity.

Hollow rocky Countries windy.

9. We before obſerved [x], that hollow and cavernous Countries have their *Waiting* or *Serving Winds*; inſomuch that thoſe Winds may truly ſeem to have their local Origins from the Earth.

10. On large rocky Mountains, the Winds are found to blow both ſooner, that is, before they are perceived in the Vallies; and more frequent, that is, whilſt the Vallies enjoy a Calm: but all Mountains and Rocks are cavernous.

11. In *Denbighſhire*, in *Wales*, which is a mountainous and rocky Country, there are ſaid to be ſuch ſtrong Eruptions of Winds from certain Caverns, as to toſs back any kind of Apparel thrown into them, a great height into the Air.

12. There are certain Holes, in a rocky Cliff at *Aber Barry*, near the *Severn* in *Wales*, whereto if the Ear be applied, various Sounds and Murmurings are heard under the Earth.

An indirect Phænomenon.

Vents of Heat and Cold in the Earth.

Acoſta obſerves, that the Towns of *Plata* and *Potoſi* in *Peru*, lie not far aſunder, and both of them ſituate in a riſing or mountainous Ground; ſo as not to differ in this reſpect; and yet, that *Potoſi* has a cold and wintery Temperature of Air; but *Plata* a mild and vernal one: which appears imputable to the Silver Mines near *Potoſi*. And this ſeems to ſhew, that there are Vents of Heat and Cold in the Earth.

Warm Exhalations from the Earth.

13. If the Earth be the *Primum Frigidum*, as *Parmenides* would have it, on a Suppoſition that Cold is cloſe linked in with Denſity; 'tis no leſs probable that warm Exhalations ſhould ariſe from the central Cold of the Earth; than that the like ſhould be thrown down by the Cold of the upper Region.

Winds in Pits.

14. There are certain Pits in *Dalmatia*, and the Country of *Cyrene*, into which, as ſome of the Ancients relate, if a Stone be thrown, a Storm will ſoon after be raiſed; as if the Stone had broke ſome Covering in the Place where Winds were impriſoned.

An indirect Phænomenon.

Air may burſt from under Ground.

Ætna, and many other Mountains, caſt up Flames: in like manner, 'tis probable, that Air may break out; eſpecially when expanded, and put into Motion, by ſubterraneal Heat.

Winds before and after Earthquakes.

15. Certain noxious and foreign Winds are obſerved to blow, both before and after Earthquakes; in the ſame manner as a certain light and rarified Smoke riſes before and after great Conflagrations.

ADMO-

[x] Sect. V. 5.

ADMONITIONS.

(1.) Air, pent up in the Earth is compelled to break out, for ſeveral Reaſons; as, (1.) becauſe ſometimes the Earth hangs looſe together, and falls into a Hollow; (2.) ſometimes the Waters make a Breach, or ingulf themſelves under the Earth; (3.) ſometimes the Air is expanded by ſubterraneal Fires, ſo as to endeavour at more room; and, (4.) ſometimes the Earth, which before was ſolid, is burnt hollow, and reduced to Aſhes by Fire; and thus being unable to ſupport itſelf, falls in; with many other Cauſes of the like kind. And ſo much for the firſt *local Origin of Winds*; *viz.* from *ſubterraneal Cauſes*. We come next to their *ſecond Origin*, or that from above; *viz.* the middle Region of the Air, as 'tis called. *Air variouſly diſcharged out of the Earth.*

(2.) Let it not be ſuppoſed we any way deny that the other Winds may likewiſe proceed from Vapours of the Earth and Sea; but what we have ſpoke to, is the firſt kind, which come out of the Earth, as Winds already formed. *That all Winds may proceed from Vapours.*

16. Woods are obſerved to murmur, before any Winds are manifeſtly perceived; whence 'tis conjectured that the Wind deſcends from on high. This is alſo obſerved in Mountains; tho the Cauſe be here more doubtful, by reaſon of their Caverns. *Winds from above.*

17. Winds follow upon the Shooting of the Stars, as 'tis vulgarly called, and come from that Quarter where the Star ſhot: whence it appears, that the Air is in commotion above, before we feel the Effects of it below. *Follow the Shooting of Stars.*

18. The opening of the Firmament, and the ſcattering of the Clouds, foreſhew Winds, before they blow upon the Earth: which, again, is a Proof that Winds begin above. *Opening of the Clouds.*

19. The ſmaller Stars are not perceived before the Wind riſes, tho the Night be clear: whence the Air ſeems to be condenſed, and rendered leſs tranſparent, by the Matter which is afterwards reſolved into Wind. *Clear Stars.*

20. Halo's about the Body of the Moon; the Sun ſetting blood-red; the Moon riſing red, on the fourth Day after the Change; with many other Prognoſticks of Winds, derived from above, ſhew the Matter of them to be there begun, and prepared. *Halo's, &c.*

21. From theſe Phænomena we may obſerve the Difference already mentioned, as to the two ways wherein Winds are generated above; *viz.* before and after the Collection of Vapours into Clouds: for the Prognoſticks from Halo's, and the Colour of the Sun and Moon depend, in ſome meaſure, upon Cloudineſs; but the Shooting and Appearance of the leſſer Stars, are obſerved in a clear Sky. *The Winds, how generated above.*

22. When Wind iſſues from a formed Cloud, either the Cloud is totally diſſipated, and converted into Wind; or ſeparated, part into Rain, and part into Wind; or rent aſunder, when the Wind burſts out as in a Storm. *The iſſuing of Winds from Clouds.*

23. There are every where many *indirect Phænomena* in Nature with regard to the Reflection by Cold; and therefore as the Cold is very intenſe in

the middle Region of the Air, Vapours cannot, generally, break thro' that Region; but muſt either be coagulated, or darted out again; according to the Opinion of the Ancients, which, in this Particular, is juſt.

A third Origin of Winds near the Earth.

24. There is a third *local Origin of Winds*, here in the lower Air; which we call by the Name of SWELLS or OVERCHARGES of the Air: the Thing itſelf is familiar and obvious; but hitherto paſſed over in ſilence.

EXPLANATION.

Winds in the lower Air, from a Surcharge.

The Generation of theſe Winds in the lower Air, proceeds after this plain manner. The Air newly made of attenuated and rarified Water and Vapour, being added to the former Maſs of the Air, the whole can now no longer be contained in the ſame Bounds; but increaſes, and rolls onwards, ſtill poſſeſſing a greater Space. Tho this depends upon two Suppoſitions; *viz.* (1.) that a Drop of Water, converted into Air, requires at leaſt a hundred times more Space than before; and, (2.) that a little new Air in motion, being ſuperadded to the old Maſs, diſturbs and puts the whole in motion; like a ſmall Blaſt coming from a Pair of Bellows, or a Crack in the Window; which give a Motion to all the Air of a Room, ſo as to diſturb the Flames of the Candles.

The Generation of ſome Winds like thoſe of Miſts.

25. As Dews and Miſts are generated, here in the lower Air, without being formed into Clouds, or reaching to the middle Region; the Caſe is the ſame with many Winds.

Breezes, what.

26. A continual Breeze ariſes from the Sea and Waters; and this Breeze is nothing more than a faint Wind, newly generated.

The Rainbow ſometimes reſolved into Wind.

27. The Rainbow, which ſeems the loweſt of all the Meteors, and generated near the Earth, is reſolved into Winds, as much as into Rain, if not more, when it appears not entire, but ſhortned at the Ends, or broken.

Some Winds generated below the Tops of Mountains.

28. Some Winds have been obſerved, in Countries ſeparated by the interpoſition of Mountains, to blow familiar on one ſide of thoſe Mountains, without coming to the other: whence 'tis plain, that ſuch Winds are generated below the Tops of thoſe Mountains.

Winds in fair Weather.

29. There are numberleſs Winds which blow in fair Weather, and in Countries where it never rains: theſe Winds are generated where they blow, without having been Clouds, or ever reaching ſo high as the middle Region of the Air.

An indirect Phænomenon.

Winds generated thro' the whole Height of the Atmoſphere.

Whoever conſiders, how eaſily Vapour is convertible into Air; how great a Quantity of Vapour there is in the World; how much larger Space a Drop of Water turned into Air poſſeſſes than before; and how greatly Air reſiſts, upon but a moderate Compreſſion; can make no queſtion that there muſt be Winds every where generated, from the Surface of the Earth to the Top of the Atmoſphere: for 'tis impoſſible that a large Quantity of

of Vapour, when it begins to expand, ſhould be raiſed to the middle Region of the Air, without ſurcharging the Air, and tumultuating in the way *w*.

SECT. VIII.

Of the accidental Productions, *or* Generations, of WINDS; *with regard to the eighth Article of the* Table of Enquiry.

TRANSITION.

WE call thoſe *accidental Productions of Winds*, which do not originally produce, or beget an impulſive Motion of the Wind; but either increaſe this Motion by Compreſſion, return it by Reflection, or cauſe it to agitate and roll by Fluctuation: which proceeds from external Cauſes, and the Poſition of contiguous Bodies. *Accidental Productions of Winds, what.*

1. In Places where there are low Hills, with Vallies ſinking about them, and again, higher Mountains riſing beyond theſe Vallies, the Air is more agitated, and the Wind more perceived, than either on Mountains or Plains. *Winds moſt perceived in Vallies.*

2. Winds and Breezes are perceived in Towns and Cities, at the meeting of two Streets; or where any wide Place runs out into a narrow Slip; and in the publick Paſſages near great Buildings. *Winds, where moſt found in Cities.*

3. Cool Rooms are made in Houſes, or happen accidentally by a Stream of Air paſſing thro' them, entering on one ſide, and going out at the other; but this is done more effectually when the Air enters in different Directions, meeting in Angles, and having a common Exit in one Corner. So likewiſe the Arching of Dining-rooms, or making them of a ſpherical Figure, contributes much to their Coolneſs; becauſe, in this Caſe, the Air is moved and reflected in all Directions. So again, winding Porches are cooler than ſuch as run ſtrait; for a Blaſt in a ſtrait Line, tho not confined, but having a free Exit, does not give ſuch an unequal rolling, and undulatory Motion to the Air, as the meeting in Angles, turning ſhort, winding about, rolling round, and the like. *Cool Rooms.*

4. After great Storms at Sea, the accidental Wind continues for a time, tho the original Wind be laid; as proceeding from a Colliſion and Percuſſion of the Air, by the Undulation of the Waves. *Accidental Winds, after Storms at Sea.*

5. The Wind, in Gardens, is commonly obſerved to be beat back by the Walls, the Building, and the Banks; ſo as to make one imagine that it blows in a contrary Direction to what it really does. *Winds in Gardens.*

6. If Hills incloſe one ſide of a Country, and the Wind blow for ſome time againſt them from the Plain, the Wind, by the bare Repercuſſion it *Winds beating againſt Hills.*

w See Page 468. *Explanation.*

ſuſtains, is either condenſed into Rain, if it be a moiſt Wind, or turned into a contrary Wind for a ſmall Continuance.

Winds in Capes. 7. Sailors frequently obſerve the Wind to change, and vary, in the Windings of Promontories.

SECT. IX.

Of extraordinary WINDS, *and* ſudden GUSTS; *with relation to the ninth Article of the* Table of Enquiry.

TRANSITION.

SOME Authors ſpeak, and complain of *extraordinary Winds*; ſuch as Hurricanes, Tornados, Fiery-winds, and ſeveral kinds of Whirlwinds; but they give no Deſcription of the Thing itſelf; which ought to be derived from Annals, ſcattered Hiſtory, and Journals of the Weather.

Sudden Guſts, how generated. 1. Sudden Guſts never happen in a clear Sky; but are always attended with Clouds and Showers; ſo that there may juſtly ſeem to be, in this caſe, a certain Eruption, a Diſploſion of the Blaſt, and a Concuſſion of the Waters.

Storms with Fogs, violent at Sea. 2. Thoſe Storms called Sea-monſters, which happen in miſty, or foggy Weather, ſupporting themſelves like a Pillar, are prodigiouſly violent, and dreaded at Sea[y].

Larger Whirlwinds uncommon. 3. The greater Tornados, which whirl round to any conſiderable diſtance, and ſnatch up Things in their way, happen ſeldom; but the leſſer, or ſportful Whirlwinds, are more frequent.

The Procedure of Hurricanes. 4. All Hurricanes, Tornados, and the greater Whirlwinds, have a manifeſt, precipitate, or vibrating Motion downwards, more than other Winds; ſo that they ſeem to ruſh, like a Torrent, and flow down, as in a Channel; and afterwards to be beat back by the Earth.

Whirlwinds. 5. It happens frequently, that Cocks of Hay are carried out of the Meadows into the Air, and thence thrown down again, like a Canopy. The ſame ſometimes happens in Fields of Peaſe, or Corn, whilſt the Crop is drying. So again, waſh'd Linen, hung out to dry, is ſometimes carried up by a Whirlwind, as high as the Tops of Trees or Houſes; and this happens without any great Force, or Violence of Wind.

Their manner of Production. 6. But ſometimes theſe ſlight Whirlwinds play in a very narrow compaſs, and even in fair Weather; ſo that a Perſon on Horſe-back, may ſee the Duſt, or light Matters, taken up, and whirled round near him, without perceiving much Wind at the ſame time. And this, doubtleſs, happens, from contrary Breezes mutually repelling each other; and cauſing a Circulation of the Air by the Shock.

7. 'Tis

[y] Storms at Sea, are rare in foggy Weather.

7. 'Tis certain, that ſome Winds leave behind them, manifeſt Signs of Burning and Scorching, on the Plains and Plants they paſs over; but for the Buſineſs of fiery Winds, which are a kind of blind Lightning, or boiling Air, without Flame; it properly belongs to the *Enquiry of Thunder and Lightning* [z]. *Burning Winds.*

SECT. X.

Of the Things contributing to Original WINDS; *in purſuance of the tenth Article of the* Table of Enquiry.

TRANSITION.

WHAT the Ancients have delivered upon the Subject of Winds, and their *Cauſes*, is very confuſed, doubtful, and but ſeldom true. No wonder any one ſhould not ſee clearly who ſtands remote. They ſpeak as if the Wind was ſomething different from Air in Motion; as if Exhalations generated, and made up the whole Body of the Winds; as if the Matter of the Winds were only a hot and dry Exhalation; and laſtly, as if the Origin of the Motion of the Winds, was only a Precipitation and Percuſſion, from the Cold of the middle Region. All which are but arbitrary Hypotheſes, and Creatures of the Imagination; and yet, from ſuch Threads as theſe, they have wove large Webs, in imitation of the Spider. But to conſult Nature upon the Point; (1.) every Impulſe of the Air makes a Wind; (2.) the Exhalations mixed with the Air, contribute more to the Motion than to the Matter of Winds; (3.) moiſt Vapours are, by a proportionate Heat, eaſier reſolved into Wind than dry Exhalations; and, (4.) numerous Winds are generated in the lower Region of the Air; and many breathe out of the Earth; beſides thoſe which are drove back, and thrown down from above. *The ancient Doctrine of Winds imperfect.*

1. We obſerved, under the *Article of general Winds*, that the natural Rotation of the Air, without any other external Cauſe, produces a perceptible Wind within the Tropicks, where the Air revolves in larger Circles. *Winds from the Rotation of the Air.*

2. Next to this natural Motion of the Air, before we proceed to enquire concerning the Sun, which is the principal Parent of the Winds; we muſt ſee whether any thing may, from clear Experience, be attributed to the Moon and the Stars. *Whether the Moon and Stars contribute to the Winds.*

3. Great and ſtrong Winds riſe ſome Hours before an Eclipſe of the Moon; ſo that if the Moon be eclipſed at Midnight, the Winds blow the ſame Evening: but if the Eclipſe of the Moon happen in the Morning, they blow the Midnight before. *Influence of the Moon's Eclipſe upon Winds.*

4. *Acoſta*

[z] See more to this purpoſe in Mr. *Bohun* of Winds;

Of the Full-Moon.

4. *Acosta* observes, that in *Peru*, which is a very windy Country, the Winds blow most at the Full-Moon.

PRECEPT.

The Effects of the Moon upon the Air to be noted.

It well deserves to be observed, what Effects the Motions and Changes of the Moon have upon the Winds; since they certainly have one upon the Waters: as for Example, whether the Winds are not somewhat more boisterous in the New and Full-Moon, than in the Quarters; the Tides being affected in the like manner. For altho it may seem a commodious Hypothesis, that the Moon rules over the Waters; but the Sun and Stars over the Air; yet 'tis certain, that Water and Air are very homogeneous Bodies; and that, next to the Sun, the Moon has here the greatest Power below.

Winds at the Planets Conjunctions.

5. 'Tis observed, that the greatest Winds blow about the time of the Conjunctions of the Planets.

At Orion's *Rising.*

6. Storms and Tempests frequently happen at the Rising of *Orion:* but it must be here examined, whether this happens not because that Constellation rises at the time of year most disposed to produce Winds; so as rather to be a *Concomitant* than a *Cause.* And the same Question may justly be put, as to the Rising of the *Pleiades*, with regard to Showers; and of *Arcturus*, with regard to Storms [a]. And so much for the Moon and Stars.

The Sun causes many Winds.

7. Doubtless the Sun is the primary Efficient of many Winds; as operating by his Heat upon two kinds of Matter; *viz.* the Body of the Air, and upon Vapours or Exhalations.

The Sun causes the Breezes betwixt the Tropicks.

8. The Sun, when powerful, expands even pure Air, perhaps a third part; which is considerable: whence, by simple Expansion, some Breeze must necessarily arise in the Path of the Sun; especially in the times of greatest Heat: and this rather two or three Hours after the Sun is up, than in the first of the Morning [b].

The Nights, whence sultry.

9. In *Europe*, the Nights are sultry; but in *Peru*, the three first Hours of the Morning: and both for the same Reason; *viz.* because the Winds and Breezes cease at those Hours.

Air made to act as Wind.

10. In a Water-Thermometer, the dilated Air depresses the Water, as if it were by a Blast; but in a Glass filled only with Air, and capt with a Bladder, the Air, when dilated, blows up the Bladder, like a manifest Wind.

Air put in motion by Heat.

11. We made an Experiment as to this kind of Wind, in a round Turret, close shut up on all sides; by placing in the midst thereof a Chafing-dish of Coals, throughly ignited, to prevent their smoking. On one side of the Chafing-dish, at some distance, we suspended a Thread furnished with a Cross of Feathers, that it might be the more susceptible of Motion; and now, when the Heat was increased, and the Air expanded, the Feather Cross, with

[a] It will come to be considered, whether the Rising of the Constellations here mentioned, be meant of their *cosmical* or *acronical* Risings; and whether the Signs of this kind are not rather *poetical* than *natural.*

[b] See Dr. *Jurin*'s Appendix to *Varenius*, pag. 37, 38.

with its String, appeared to be agitated, and moved about various ways: then, making a Hole in the Window of the Turret, there iſſued out a warm Exhalation; not in a continued Stream, but by fits, in an undulating manner.

Wind by a Condenſation of the Air.

12. So, likewiſe, the Condenſation of the Air by Cold, after having been dilated, creates the ſame kind of Wind; tho weaker, by reaſon of the leſſer Force of the Cold. And hence, in *Peru*, there is not only a greater Coolneſs perceived under every little Shade than here with us; but alſo a manifeſt Breeze, from the ſhrinking and contracting of the Air, when it enters the Shade. And thus much for Wind cauſed by a mere Dilatation, and Contraction of the Air.

Vaporous Winds.

13. The Winds proceeding from the mere Motions of the Air, without any Mixture of Vapour, are ſoft and gentle. We muſt next examine into the *vaporous Winds*, or thoſe produced from Vapour; which may prove as much ſtronger than the former, as the Expanſion of a Drop of Water turned into Air, exceeds the Expanſion of Air, already produced; which it does by many degrees, as we before obſerved[c].

Vapours turned into Air.

14. *Vaporous Winds*, which are thoſe that commonly blow, are cauſed by the Sun with its proportionate Heat; and the Matter of them are Vapours and Exhalations, converted and reſolved into actual Air; tho not quite perfect at its firſt Formation.

And Wind.

15. A ſmall Heat of the Sun raiſes but little Vapour; and therefore cauſes but little Wind.

How Vapours generate Wind and Rain.

16. A moderate Heat of the Sun raiſes Vapours, and does not preſently diſperſe them again; ſo that, if the Quantity thereof be large, they collect into Rain, either alone, or attended with Wind; but if the Quantity be ſmall, they are turned into ſimple Wind.

17. The Heat of the Sun, upon its Increaſe, has a greater tendency to the Production of Wind; but in its Decreaſe, to the Production of Rain.

How fair Weather is produced.

18. A ſtrong and continued Heat of the Sun, rarifies, diſperſes, and ſublimes the Vapours; at the ſame time mixing them equably, and incorporating them with the Air: whence the Air becomes calm and ſerene.

Unequal Heats moſt productive of Winds.

19. A more equable and continued Heat of the Sun, is leſs diſpoſed to produce Winds; but an unequal, and changeable Heat, is more diſpoſed to produce them. Whence Sailors, in a *Ruſſia* Voyage, are leſs expoſed to Winds than in the *Britiſh* Channel, becauſe of the long Days; but in *Peru*, under the Equinoxial, the Winds come thick; by reaſon of the great Inequalities of Heat between the Day and Night.

The Quantity and Quality of Vapours.

20. Both the Quantity and Quality of Vapours muſt be regarded. A ſmall Quantity produces gentle Gales; and a middling Quantity ſtronger Winds; but a large one over-loads the Air, and produces Rain either attended with a Calm, or Wind.

Winds from the Earth more laſting.

21. Vapours ariſing from the Sea, Rivers, and Lands overflowed, produce a much greater Quantity of Wind, than terreſtrial Exhalations; but the Winds

[c] Let the proper Uſe be here made of the *Æoliple*; and the proper Experiments tried, in imitation of Nature, for turning Water, if poſſible, into true and permanent Air.

Winds that ariſe from the Earth, and drier Places, are more obſtinate and durable; and prove, generally, ſuch as are thrown from above: ſo that the Opinion of the Ancients has its Uſe in this reſpect; only they thought fit to divide the Right, and aſſign Rains to the Vapours, and nothing but Exhalations to the Winds; with the like Diſtributions; which look pretty in Diſcourſe, tho they are but empty at the Bottom.

The Winds from melted Snows.

22. Winds proceeding from the melting of Snow upon the Tops of Mountains are of a middle Nature, betwixt aquatick and terreſtrial Winds; but they rather incline to the aquatick: being, however, more ſharp and active.

23. We formerly obſerved, that the melting of Snow upon the ſnowy Mountains, always produces Stated Winds on the ſide where it melts.

24. So likewiſe the anniverſary North Winds, that happen about the Riſing of the Dog-Star, are thought to proceed from the Frozen-Sea, and the Parts about the Artick-Circle; where Thaws happen late, or when the Summer is advanced.

From Ice.

25. The huge Maſſes, or Mountains of Ice, carried down towards *Canada* and *Newfoundland*, rather produce certain cold Breezes, than variable Winds.

From Sands.

26. The Winds that blow from chalky and ſandy Lands, are few and dry; but, in the hotter Countries ſultry, ſuffocating and ſcorching.

From Sea-Vapours, and Land-Exhalations.

27. The Winds ariſing from Sea-Vapours, eaſily fall back again into Rain, or the Water whereof they were made; or, if they do not this, they ſoon mix along with the Air, and grow quiet: but terreſtrial, ſmoky and unctuous Exhalations, are reſolved with greater difficulty, mount higher, are more irritated in their Motion, frequently enter the middle Region of the Air, and help to compoſe the Matter of fiery Meteors.

Winds from burning Vegetables.

28. 'Tis reported here in *England*, that at the time when *Gaſcony* was under our Juriſdiction, the Subjects of *Bourdeaux*, and the neighbouring Parts, petitioned the King, that the burning of Heath might be prohibited in *Suſſex*, and *Hampſhire*; becauſe it produced a Wind about the end of *April*, deſtructive to their Vines.

The meeting of Winds.

29. The meeting of ſtrong Winds one againſt another, produces violent Whirlwinds; but if they are only gentle and moiſt, their meeting produces Rain, and a Calm.

Winds allay'd five ways.

30. Winds are checked and allay'd five ways; *viz.* (1.) when the Air, loaded and tumultuating with Vapours, is freed from them by their contracting themſelves into Rain; (2.) when the Vapours are rarified, diſſipated, and ſo mixed kindly in along with the Air, and grow quiet therewith; (3.) when the Vapours, or Exhalations, are raiſed up, or ſublimed, to a great heighth; ſo as to acquire a ſtate of Reſt, till they either penetrate the middle Region of the Air, or are thrown down by it; (4.) when Vapours, collected into Clouds, are carried into other Countries by Winds blowing from on high, ſo as not to diſturb the Countries over which they paſs; and, (5.) when the Winds blowing from their Origins, continue their Motion a long way, without any new Supply of Matter; but at length ſlacken, loſe of their Force, and ſink of courſe.

31. Showers

31. Showers generally allay the Winds; eſpecially ſuch Winds as are ſtormy: and Winds, on the other hand, frequently keep up Showers. *Showers and Winds prevent each other.*

32. Winds contract themſelves into Rain, (1.) either by being oppreſſed with Weight, when the Vapours are copious; or, (2.) by means of the contrary Motions of gentle Winds; (3.) by the Obſtruction of Mountains and Promontories, which ſtop the Force of the Winds, and gradually turn them back upon themſelves; and, (4.) by intenſe Cold, which condenſes them. And this Contraction into Rain, is the firſt and principal of the five Ways whereby Winds are laid [d]. *Winds, how turned into Rain.*

33. The ſmaller and more gentle Winds generally riſe in the Morning, and fall when the Sun ſets; the nocturnal Condenſation of the Air being ſufficient to contract them: for Air will ſuffer ſome degree of Compreſſure without any great Reluctance. *Winds riſing and falling with the Sun.*

34. The ringing of Bells is thought to diſſipate Thunder and Lightening; but the ſame is not obſerved as to Winds [e]. *Whether ringing of Bells may allay Wind.*

35. *Pliny* relates, that the Violence of a Whirlwind may be broke by the playing of Vinegar in amongſt it. *Whirlwinds laid by Vinegar.*

ADMONITION.

Let the Prognoſticks of Winds be here conſulted; for there is ſome Connexion between Cauſes and Signs. *Prognoſticks of Winds to be conſidered.*

SECT. XI.

Of the Limitations of the WINDS; *in purſuance of the eleventh Article of the* Table of Enquiry.

1. 'TIS related of *Mount Athos*, and *Mount Olympus*, that the Prieſts who yearly ſacrificed upon their Tops, uſed to find the Writing they had drawn in the Aſhes of the Sacrifice one Year, no way diſordered or obliterated, when they returned the next; altho theſe Altars did not ſtand in a Temple, but in the open Air: whence it was manifeſt, that at ſuch a height there fell no Showers, and blew no Winds [f]. *Winds reach not to the Tops of ſome Mountains.*

2. They relate, that on the *Pike of Teneriff*; as alſo upon the *Andes*, betwixt *Peru* and *Chili*; there lies Snow along the Cliffs and ſides of the Mountains; whilſt upon the Tops thereof the Air is quiet; but ſo ſubtil as hardly to ſuffice for Reſpiration; and ſo acrimonious and pungent as to inflame the Eyes, and give a Nauſea to the Stomach.

[d] See above, § 30.

[e] It is reported, that ſtormy Winds are frequently laid by the firing of Cannon, in Sea-Fights.

[f] See hereafter *Sect.* XIV.

Vaporous Winds not high.

3. Vapourous Winds ſeem not to blow at any great height; tho 'tis ſtill probable that ſome of them aſcend higher than moſt Clouds [s]. And ſo much for the Height; next for the Breadth of Winds.

The Breadth of Winds.

4. 'Tis certain, that the Spaces poſſeſſed by Winds are very various; being ſometimes extremely wide, and ſometimes ſmall and narrow. They have been found to range a hundred Miles in a few Hours.

Spreading Winds not violent.

5. Diffuſive Winds, if free, are generally vehement, and durable; commonly continuing twenty-four Hours; but not rainy. On the contrary, narrow, or confined Winds, are either gentle, or ſtormy; but always ſhort-lived.

Stated Winds travel far,

6. Stated Winds are itinerant; and travel over vaſt Spaces.

Stormy Winds confined.

7. Stormy Winds run not out far; tho always beyond the Limits of the Storm itſelf.

Sea-Winds confined.

8. Sea-Winds blow within much narrower Bounds than Land-Winds; inſomuch, that at Sea they ſometimes obſerve a briſk Gale driving the Waters on one ſide; as appears by the ruffling and curling thereof; whilſt every where elſe there is a Calm; and the Sea remains as flat as a Looking-glaſs.

Little Whirlwinds very confined.

9. We before obſerved, that little ſportful Whirlwinds ſometimes play with the Duſt upon the Road, like the Blaſt of a Pair of Bellows. And ſo much for the *Extent* of the Winds: next for their *Duration*.

Strong Winds continue longer at Sea than Land.

10. Very ſtrong Winds at Sea continue for a long while; as there receiving a large Supply of Vapour: but at Land, they ſcarce continue above a Day and a half.

Gentle Winds variable.

11. Very gentle Winds continue not to blow conſtantly, for above three Days, either at Sea or Land.

Morning Winds laſt the longeſt.

12. The Eaſt Wind, we before obſerved, is more laſting than the Weſt; and whatever Wind begins to blow in the Morning, uſually continues longer than that which riſes in the Evening.

Strong Winds fall ſuddenly.

13. 'Tis certain, that Winds riſe and increaſe by degrees, unleſs when they are perfectly ſtormy; but fall quicker, and ſometimes all at once.

SECT. XII.

Of the Succeſſions of the WINDS; *with regard to the twelfth Article of the* Table of Enquiry.

The Wind ſeldom retrograde.

1. WHEN the Wind changes conformably to the Motion of the Sun; that is, from Eaſt to South; from South to Weſt; from Weſt to North; and from North to Eaſt; it ſeldom goes back; or if it does 'tis only for a ſhort time: but if it moves in a contrary Direction; *viz.* from Eaſt to North; from North to Weſt; from Weſt to South; and from South

[s] Which is ſeldom high; or much above half, or a quarter of a Mile, as has been often meaſured.

South to East; it generally returns to the former Point, at leaſt before it has gone thro' the whole Circle.

2. If Rain comes firſt, and the Wind begins to blow upon it, the Wind continues longer than the Rain; but if the Wind blow firſt, and is afterwards laid by the Rain, the Wind ſeldom returns; or if it does, it alſo rains afreſh. *The Succeſſion of Wind and Rain.*

3. When Winds continue to vary for a few Hours, as if it were to try in which Point they ſhould ſettle, and afterwards begin to blow conſtant; they continue for many Days. *Varying Winds coming to ſettle, are conſtant.*

4. If the South Wind begins to blow for two or three Days, the North Wind will ſometimes blow ſuddenly after it: but if the North Wind blows for the ſame Number of Days; the South Wind will not riſe till after the Eaſt has blown a while. *The Eaſt Wind interpoſes betwixt the North and South Wind.*

5. When the Year is upon the Decline, and Winter coming on; if the South Wind blow at the beginning of the Winter, and afterwards the North; the Winter will prove froſty: but if the North Wind blow at the beginning of the Winter, and afterwards the South; the Winter will be mild and warm. *The State of the Winter prognoſticated by the ſucceſſion of Winds.*

6. *Pliny* relates, from *Eudoxus*, that Winds return in the ſame Series every four Years: which ſeems no way true; for the Revolutions of the Winds are not ſo quick. But the diligence of ſome has reached ſo far as to obſerve, that the greater and more remarkable Changes, ſuch as Heats, Snows, Froſts, warm Winters, and cold Summers, generally return in a Circle of thirty Years. *Revolutions of Wind and Weather.*

SECT. XIII.

Of the Motions of the WINDS; *in purſuance to the thirteenth Article of the* Table of Enquiry.

I.

TRANSITION.

MEN expreſs themſelves as if the Wind were a certain Body, that, of itſelf, impelled, and drove the Air before it, by its own Force; and when it changes, they ſpeak as if the Wind had removed itſelf to another Place: and, whilſt the Populace talk in this manner, Philoſophers do not correct ſuch Notions; but, inſtead of ſtopping the Error, give ſomewhat into the ſame themſelves. *Authors ſpeak inaccurately of the Winds.*

1. Having, therefore, already enquired into the local Origins of Winds; we are next to enquire into the *Excitation* and Direction of their Motion. And for the Winds which have their Motion begun in their firſt Impulſe; *The Excitation and Direction of Winds.*

as thoſe have which are thrown down from above, or breathe out of the Earth; the Excitation of their Motion is manifeſt: but others deſcend, and ſome aſcend in their Beginning; and afterwards acquire a rolling Motion, from the Reſiſtance of the Air; chiefly according to the Angles wherein their Force is directed. But for ſuch as are produced every where in the lower Part of the Atmoſphere, as the commoneſt Winds are, the Enquiry about them ſeems difficult and obſcure, tho the Thing itſelf be but vulgar; as we obſerved in the *Explanation* under the ſeventh *Section* [h].

The Experiment of producing Wind in a cloſe Turret, varied.

2. We find ſome Reſemblance of this Matter, in the cloſe Turret mentioned above; for we varied our Experiment three ways: the firſt was that already mentioned [i], with a Chafing-diſh of Charcoal thoroughly ignited. The ſecond was, by uſing a Veſſel of hot Water, without the Chafing-diſh; and then the Motion of the Feather-Croſs was ſlower, and leſs active than before; the dewy Vapour of the Water now hanging in the Air, unreſolved into the Matter of Wind, thro' the weakneſs of the Heat. The third Variation was made by continuing both the Chafing-diſh and the Veſſel of Water in the Room, and then the Croſs was agitated much more than ever; ſo as ſometimes to be toſſed upwards in an Eddy, as if by a little Whirlwind; the Water now affording a Quantity of Vapour, and the Fire adjacent driving and diſperſing it about [k].

Cauſe of the Winds Excitation.

3. And therefore a principal *Cauſe* of the Excitation of the Wind's Motion, is the ſurcharging of the Air, by a new Addition of Air produced from Vapours. We proceed next, to the Direction of the Wind's Motion; or its *Verticity*, which is its change of Direction.

Its progreſſive Motion from Nurſeries or Springs.

4. The Direction of the Wind's progreſſive Motion is governed by the *Nurſeries*, which ſerve as Fountains to Rivers; *viz.* ſuch Places as contain a larger Collection of Vapours; and are as the native Country of Winds. But when they find a Current, or meet with little Reſiſtance from the Air, then, like Water in a Declivity, they receive and ſweep away all the light Matter they find in their Courſe, and mix it with their own Stream, after the manner of Rivers: and therefore Winds always blow from the Quarter where their Springs or Nurſeries lie.

Winds without Nurſeries eaſily vary.

5. When the Winds have no remarkable *Nurſeries* in a certain Place, they change, or wander about extremely; and eaſily alter their Current; as in the middle of the Sea, and wide extended Plains.

Whence Winds blow differently ſtrong.

6. When there are great Nurſeries of Winds in one Place, but the Winds receive ſmall Additions from the Places they paſs thro', they blow ſtrong at the Beginning; and flag by degrees: on the contrary, where their Nurſeries are farther continued; they blow gently at firſt, and ſtronger afterwards.

Moveable Nurſeries of Winds.

7. There are *moveable Nurſeries* of Winds; *viz.* in the Clouds; which are frequently carried by the Winds that blow aloft, into Countries very diſtant

[h] See Page 468.

[i] See above, *pag.* 472. § 11.

[k] Experiments of this kind might eaſily be contrived and made; ſo as to give great Light and Information in many Parts of the preſent Subject.

diſtant from the Origin of thoſe Vapours that produced the Clouds: and in this caſe the Nurſery of the Wind begins on that ſide, where the Clouds begin to reſolve into Wind.

8. But the *Verticity* [l] *of the Winds* does not happen, becauſe the Wind tranſports itſelf in blowing; but becauſe it is either laid of itſelf, or ſubdued by another Wind: and this whole Affair depends upon the various Situations of the Nurſeries of Winds, and the Varieties of Times and Seaſons wherein the Vapours iſſuing from theſe Nurſeries are reſolved. *The Verticity of Winds, whence.*

9. If there are Nurſeries of Winds in oppoſite Points; as one to the South, another to the North; the ſtronger Wind will prevail, and blow conſtant, without any contrary Wind appearing; yet ſo as to be ſomewhat checked and deaden'd by the weaker Wind; as the Tide is by the Courſe of a River, where the Motion of the Sea prevails; tho it be ſomewhat reſiſted by that of the River. But if one of the two contrary Winds, which at firſt was the ſtronger, happens to fall; the other will now ſuddenly blow in its own contrary Direction, wherein it blew before; tho it lay concealed under the Power of the ſtronger. *From oppoſite Nurſeries.*

10. So, for Example, if there be a Nurſery of Wind to the North-Eaſt; the North-Eaſt Wind will then blow: but if there be two Nurſeries, the one to the Eaſt, and the other to the North; the two reſpective Winds will blow ſeparate, for a certain Tract; but, after their *Angle of Confluence*, they will blow North-Eaſt; or vary from that Direction, according as one Nurſery proves ſtronger than the other [m]. *How the Winds blow from different Nurſeries.*

11. If there be a ſtrong Nurſery of Wind to the North, at twenty Miles diſtance from any Country, and a weaker to the Eaſt at ten Miles diſtance; the Eaſt Wind will blow firſt, for ſome Hours; and ſoon after, when that has run its Courſe, the North. *Winds change their Direction according to their Obſtacles and Reflections.*

12. If the North Wind blow, and meet a Mountain in its way, from the Weſt; it will ſoon after blow North-Eaſt; or a Blaſt compounded of the original and the reflected Wind.

13. If there be a Nurſery of Winds in the Earth, to the North, and the Blaſt go right upwards, and meet a cold Cloud from the Weſt, which reflects it to the oppoſite Point; it will blow North-Eaſt.

ADMONITION.

In the Earth and Sea the Nurſeries of Winds are ſtable; ſo that their Spring and Origin may here be the better perceived: but being moveable in the Clouds, the Matter of them may be ſupplied in one Place, and the Winds formed in another; which occaſions the Direction of their Motion to be more confuſed and uncertain. The Caſes above produced are in the way of Examples, that may ſerve for all Caſes of the like kind. And ſo much for the Direction of the *Wind's Motion:* but for the *Courſes* or *Voyages of the Winds*; tho we have touched upon them before, under the Title of *Some Nurſeries of Winds ſtable, others moveable.*

[l] See above, § 3.

[m] According to the common *Laws* of Motion and Hydroſtaticks.

of the *Breadth of the Winds*, we muſt here enquire a little farther into them; ſince the Breadth of the Winds may be unſkilfully taken for their Length, if they ſhould prove wider than they are long, in their Sweep or Progreſſion.

That Winds may have a long Courſe.

14. If it were true, that *Columbus* could form a Judgment of the Continent of *America* from the ſtated weſtern Winds on the Coaſt of *Portugal*; it would be certain that the Winds might take a very long Journey.

15. If it be true, that the thawing of the Snows about *Scandia* and the *Frozen-Sea*, raiſes a North-Wind in *Italy*, *Greece*, &c. in the Dog-days, 'tis a very long way for Winds to travel.

16. It has not hitherto been obſerved how much ſooner, in order of the Wind's Motion, a Storm comes to any Place from one Quarter, than from another: for Example, how much ſooner from the Eaſt; with the Wind at Eaſt; than from the Weſt. And ſo much for the *progreſſive Motion* of the Winds: we come next to their *Undulation*.

The Undulation of the Winds.

17. The Winds undulate quick; ſo that even a ſtrong Wind fluctuates, or riſes and falls alternately, at leaſt a hundred times in an Hour; which ſhews the Force of the Winds to be interrupted: whereas Rivers, tho rapid; and Currents of the Sea, tho ſtrong; have no Undulation, except from the Winds. Nor is this Undulation of the Winds any way equable; but, like the Pulſe, ſometimes intermits, and ſometimes returns double.

The Difference between the Undulation of the Winds and Waters.

18. The Undulation of the Air differs from that of Water in this, that in Water, after the Waves are riſen they fall again ſpontaneouſly, to a Flat: ſo that, notwithſtanding the lofty poetical Deſcriptions of Tempeſts raiſing the Waves to the Skies, and ſinking them again to the Abyſs; there is no conſiderable Deſcent perceived of them, below the level Surface of the Water: but in the Undulation of the Air, where the Motion of Gravity is leſs, the Air is raiſed and depreſſed almoſt equally. And ſo much for the *Undulation of the Winds:* next for their *Motion of Conflict*.

Conflicts and compound Currents of Winds.

19. We have already made ſome Enquiry into the *Conflicts* and *compound Currents of the Winds*. 'Tis manifeſt that Winds, eſpecially the gentle ones, blow indifferently any where; there being few Days or Hours wherein ſome gentle Breezes are not perceived in open Places; and that with great Inconſtancy and Variety: for thoſe Winds which proceed not from any larger Nurſery, wander and roll about, as if ſporting with each other; ſometimes meeting, and ſometimes disjoining, and flying aſunder.

Contrary Winds meeting at Sea.

20. Two contrary Winds are ſometimes obſerved to meet at Sea; as appears from the ruffling of the Surface of the Water on either ſide of the Ship; and the ſtillneſs of the Water in the middle: and after the Shock there one while enſues a general Calm on the Water; that is, when the Winds equally break each other on both ſides; and another while, a continued ſtruggle and agitation of the Water; when the ſtronger Wind prevails.

21. The Winds are certainly often obſerved to blow one way on the Mountains of *Peru*; and, at the ſame time, a contrary way in the Vallies below. *Winds blowing contrary ways at once.*

22. 'Tis likewiſe certain, that the Clouds, here with us, are driven one way, whilſt the Wind blows another.

23. Again, 'tis certain, that the higher Clouds are ſometimes found to fly over the lower; ſo as to go different, and even contrary ways; like oppoſite Currents.

24. 'Tis likewiſe certain, that there is ſometimes a Calm aloft in the Air; whilſt a rude Storm blows below, for the ſpace of half a Mile.

25. On the other hand, there is ſometimes a Calm below, whilſt the Clouds move briſk above; tho this happens but ſeldom.

26. Nor ſhould the Teſtimony of *Virgil* be wholly omitted; as he had ſome Notion of *Natural Philoſophy*. He makes the *Eaſt*, *South-Weſt*, and *Weſt* Wind blow at once; and again, all the Winds to combat together *.

An indirect Phænomenon.

It happens alſo in Waves, that ſometimes the upper, and ſometimes the lower Water moves the quickeſt; and ſometimes, tho rarely, there are found two different Currents of Water, one above and another below, moving in contrary Directions. And thus much for the *natural Motions* of the Winds: we next proceed to their *Motions in artificial Machines*; but principally in the Sails of Ships. *Currents in the Air.*

II.

Of the Motion of the Winds, in the Sails of Ships.

1. WE here chuſe, for our Example, the largeſt *Britiſh* Ships, which have four and ſometimes five Maſts, all ſtanding erect, in a ſtrait Line, one behind another, along the middle of the Ship. Their Names are the *Main-Maſt*, which ſtands in the Centre; the *Fore-Maſt*, the *Mizzen-Maſt*, which is ſometimes double; and the *Bow-ſprit*. *The Maſts of the* Engliſh *Men of War.*

2. Each Maſt conſiſts of Pieces, which may be crampt and joined to each other; and again taken down at pleaſure: ſome have three, others but two of theſe Pieces. *The Maſts have ſeveral Pieces.*

3. The *Bow-ſprit* ſtands inclined to the Sea from its lower Juncture; but from its upper, erect: and all the other Maſts ſtand perpendicular. *The Poſition of the Maſts.*

4. Theſe Maſts are rigged with ten Sails; and when the *Mizzen-Maſt* is double, with twelve. The *Main-Maſt* and *Fore-Maſt*, have three Tier of *The Sails.*

Sails

* *Unà Eurus, Notuſque ruunt, creberque procellis*
Africus,————
Omnia Ventorum concurrere Prœlia vidi.

Sails; which we call the *Main-Sail*, the *Top-Sail*, and the *Main-top-Sail*. The other Maſts have only two Sails, without a *Main-top-Sail*.

The Poſition of the Sails. 5. The Sails are ſpread a-croſs, near the Top of each Joint of the Maſt, by means of certain Rods, or Yards, to which the upper-part of the Sail is fixed; the Bottom is tied with Ropes only at the Corners; the Main-Sails being thus faſtened to the ſides of the Ship; and the Main-top-Sails to the Yards, immediately below them. And by the ſame Ropes they are ſhifted, or turned, to either ſide, at pleaſure.

The Yards. 6. The Yard of every Maſt goes athwart the Maſt; only thoſe of the Mizzen-Maſt hang aſlope; the one end being elevated, and the other depreſſed: but in the reſt they make right Angles with the Maſt.

Figure of the Sails. 7. The Sails of the Main-Maſt, Fore-Maſt, and Bow-Sprit, are of a quadrangular, or parallelogram Figure; but the Top and Main-top-Sails riſe ſomewhat narrow; whilſt the Main-Sail of the Mizzen-Maſt is triangular; and the Top-ſail ſharp or pointed.

The Meaſure of the Main-Sail, of the Main Maſt. 8. A Ship of eleven hundred Tun, a hundred and twelve Foot long in the Keel, and forty Foot wide in the Hold, carried the Main-Sail of its Main-Maſt forty-two Foot, deep and eighty-ſeven Foot wide.

Top-Sail of the Main-Maſt. 9. The Top-Sail of the ſame Maſt was fifty Foot deep; eighty-four Foot wide at the Baſis; and forty-two at the Top.

Maintop-Sail. 10. The Main-top-Sail was twenty-ſeven Foot deep, forty-two Foot wide at the Baſis, and twenty-one at the Top.

Fore-Maſt Main-Sail. 11. The Main-Sail of the Fore-Maſt was forty Foot and an half deep, and ſeventy-two Foot wide.

Top-Sail. 12. The Top-Sail of the ſame Maſt was forty-ſix Foot and a half deep, ſixty-nine Foot wide at the Baſis, and thirty-ſix a-top.

Main-top-Sail. 13. The Main-top-Sail of the ſame Maſt was twenty-four Foot deep, thirty-ſix Foot wide at the Baſis, and eighteen a-top.

Mizzen-Main-Sail. 14. The Mizzen-Main-Sail was fifty-one Foot deep, from the elevated Yard-Arm, and ſeventy-two Foot wide where it joins to the Yard; the other part ending ſharp.

Top-Mizzen-Sail. 15. The Top-Mizzen-Sail was thirty Foot deep, fifty-ſeven Foot wide at the Baſe, and thirty a-top.

If two Mizzen-Sails. 16. If there be two *Mizzen-Maſts*, the Sails of the hindmoſt are leſs, by about a fifth part, than thoſe of the foremoſt.

Main-Sprit-Sail. 17. The *Main-Sail of the Bow-Sprit* was twenty-eight Foot and a half deep, and ſixty Foot wide.

Top-Sail. 18. The *Top-Sail* thereof was twenty-five Foot and a half deep, ſixty Foot wide at the Baſe, and thirty a-top.

Proportion of the Maſts and Sails variable. 19. The Proportions of the Maſts and Sails of Ships vary, not only with the Rate or Size of the Ship, but alſo according to the different Uſes for which they are built; as whether for Fight, Freight, Swift-ſailing, *&c.* But there is no manner of correſpondence between the Dimenſions of the Sails, and the Ships Burden, or number of Tuns ſhe carries; for a Ship of about five hundred Tuns carries the Main-Sail of its Main-Maſt but a few ſquare Feet leſs than another of twice the Burden. Whence it is, that

ſmall

ſmall Ships are much better Sailers than the larger; not only becauſe of their Lightneſs, but alſo becauſe of the Largeneſs of their Sails, with reſpect to the bulk of the Ship: for it would be an unwieldy and impracticable thing, to preſerve this Proportion in the larger Shipping.

20. As all the Sails are ſtretched full out at their Tops, and faſten'd only by their Corners at the Bottom; the Wind muſt of neceſſity ſwell the Sails; eſpecially towards the Bottom, where they are ſlackeſt. *Whence the Sails ſwell.*

21. This Swell of the Sails is much greater in the Main-Sails, than in the reſt; not only becauſe thoſe Sails are Parallelograms, and the others narrower upwards, or pointed; but again, becauſe the width of the Yard far exceeds the width betwixt the Ship's two ſides, to which 'tis faſten'd: whence, of neceſſity, theſe Sails yield, by their Slackneſs, a large Boſom to the Wind; inſomuch, that in the great Ship we have choſe for our Example, this Swell, in ſailing before the Wind, may bulge out nine or ten Foot from the Plain of the Sail. *Greateſt Swell in the Main-Sail.*

22. And for the ſame Reaſon, all Sails ſwelled with Wind, form themſelves into an Arch, at the Bottom; ſo that much of the Wind muſt neceſſarily miſs them: and this Arch, in the great Ship above-mentioned, will, in its Height, equal the Stature of a Man. *Sails arched by the Wind.*

23. But in the triangular Sail of the Mizzen-Maſt, the Swell muſt needs be leſs than in a quadrangular Sail; as well by reaſon of the leſs capacious Figure, as becauſe in a quadrangular Sail there are three Sides ſlack, and but two in a triangular one: whence the Wind is received more ſtifly in the triangular Sail.

24. The nearer the Wind's Motion comes to the Head of the Ship, the more powerful it proves, and ſets her forward the faſter; becauſe 'tis ſpent upon a Part where the Waves are eaſieſt cut by the ſharp Make of the Prow: but principally, becauſe a Motion at the Head draws the Ship along; whilſt a Motion in the Stern only protrudes her. *A Wind near the Ship's Head powerful.*

25. The Wind's Motion in the higher Tiers of Sails, ſets the Ship forwards more than in the lower Tiers; becauſe all ſtrong Motions are moſt effectual, when far removed from the Reſiſtance; as we ſee in Levers, and the Sails of the Wind-mill: but for fear of over-ſetting the Ship, the higher Sails are made tapering, to prevent their carrying too much Wind; and are chiefly uſed at ſuch times when little Wind is ſtirring. *The upper Sails powerful.*

26. When Sails are placed in a ſtrait Line, one behind another, the hindmoſt muſt neceſſarily take the Wind from the foremoſt, when it blows foreright: and therefore, tho they were all ſpread at once, yet the Wind would have little Force upon any more than thoſe of the Main-Maſt; and a little upon the Main-Sail of the Bow-Sprit. *Sails, why not placed in a ſtrait Line.*

27. The moſt commodious and advantageous Diſpoſition of the Sails before a Wind, is to hoiſt the two lower Sails of the Fore-maſt [p]; where, as we ſaid, the Motion is the more effectual: and again, alſo the Top- *The Sails, how beſt ſpread before a Wind.*

[p] *Viz.* near the Ship's Head. See above § 24.

Sail of the Main-Maſt [q]; as there will ſtill be left Space enough underneath, for the Wind to fill the lower Fore-ſails, without robbing them too much.

Why Ships ſail better with a ſide Wind.

28. By reaſon of the Back-ſails thus taking the Wind from the Fore-ſails, a Ship makes more Way with a ſide Wind, than with a direct Wind; for in a ſide Wind, all the Sails may be crouded, without taking the Wind from one another; as they all turn Side to Side.

The beſt Wind for ſailing.

29. Again, the Sails are ſtiffer ſtretched againſt a ſide Wind; which ſtretching ſomewhat compreſſes the Wind, and directs it to the Part where it ſhould blow: whence it acquires ſome additional Strength. But that Wind is the moſt advantageous which blows in the Quarter, between a fore Wind and the ſide one [r].

The Main-Bow-Sprit-Sail ſeldom uſeleſs.

30. The Main-Sail of the Bow-Sprit can ſcarce ever prove uſeleſs; as being not liable to be robbed of its Wind; which it receives from that blowing every way about the Ship-ſides, and under the other Sails.

An Impulſe, and a Direction, in ſailing.

31. In the Motion of the Winds in Ships, there is obſerved both an Impulſe, and a Direction: but that Direction which belongs to the Rudder, does not greatly concern the preſent Enquiry; only as it has a Connexion with the Motion of the Winds in the Sails.

TRANSITION.

The Mizzen-Main-Sail aſſiſts the Helm.

As the Motion of Impulſe is in vigour at the Head; ſo is the Motion of Direction at the Stern; and therefore the Main-Sail of the Mizzen-Maſt, is of great moment to the Impulſe; and proves, as it were, an Aſſiſtant to the Helm.

Uſe of the Mizzen-Main-Sail in unfavourable Winds.

32. As the Mariners-Compaſs is divided into thirty-two Points, ſo that each Semi-circle thereof contains ſixteen; a Ship may ſail in Progreſſion, without Traverſing, (as is uſual in contrary Winds,) even tho of thoſe ſixteen Points, ten be oppoſite; and only ſix of them favourable: but this greatly depends upon the Main-Mizzen-Sail; for as the Points of the Wind now prevail which are contrary to the Ships Courſe, and cannot be governed by the Helm alone; they would turn the other Sails, and the Ship itſelf, a contrary Way; but that this Sail holding tort, favours the Helm, ſtrengthens its Motion, and turns and brings about the Ship's Head into the Way of her Courſe.

Winds load the Ship.

33. All Wind in the Sails, ſomewhat loads and ſinks the Ship; and this the more, as it blows from aloft: and therefore, in great Storms, they firſt lower their Yards, and down with the Top-Sails; and next, if there be Occaſion, down with all the reſt; even cutting away the Maſts themſelves, and throwing their Guns, Lading, *&c.* over board; to lighten the Ship, and keep her floating, at the Mercy of the Waves.

34. With

[q] See § 25.

[r] Ships differ greatly in Sailing; according to accidental Circumſtances in their Make, Trimming, *&c.* Thus ſome Ships that ſail excellently with their Maſts upright, will ſcarce ſail at all with them reclined; and *vice verſâ*.

34. With a briſk and favourable Gale, even a Ship of Burden may ſail a hundred and twenty *Italian* Miles in four and twenty Hours. There are certain Packet-Boats, wholly built for Sailing, that will make much more Way. But when the Wind is directly in their Teeth; as a laſt, tho feeble Shift to advance, they traverſe, or cut away croſs and croſs, out of their Courſe; ſhifting their Sails as the Wind requires; then bend up towards their Courſe again: and thus by repeating theſe angular Trips, they get right forwards; tho perhaps but at the Rate of fifteen Miles in twenty-four Hours.

How faſt a Ship may ſail with a fair Wind.

Traverſing.

Larger OBSERVATIONS.

1. THIS Motion of the Winds, in the Sails of Ships, has three principal Origins, and Fountains of its Impulſe, from whence it is derived; and from whence alſo, Rules may be formed for increaſing and ſtrengthening it.

The Origins of the Impulſe in Sailing.

2. The firſt Fountain is, from the Quantity of the Wind received; for 'tis plain, that much Wind, here contributes more than a little; and therefore a ſufficient Quantity of Wind muſt be carefully procured. The Means to procure it is, in the way of Thrift and good Huſbandry, to prevent being robbed of it; and therefore, *as much as poſſible, let no Wind be loſt, miſemployed, or taken from the Ship.*

Affords Rules for increaſing it.

3. The Wind blows either above the Ship's ſides, or below them, towards the Surface of the Sea; and as, in the way of good Huſbandry, 'tis uſual to be very careful of ſmall Matters, (for every body takes care of large ones;) ſo a *particular regard muſt be had to theſe lower Winds*; tho they doubtleſs are of leſs Efficacy than the higher.

To ſave the low Winds.

4. As for the Winds which play chiefly about the Ship's ſides, and under the Sails; 'tis the true Office of the Main-Sail of the Bow-Sprit to prevent their being loſt: this Maſt ſtanding low, and aſlope, ſo that its Main-Sail may receive them; and therefore become ſerviceable, without taking from the Winds intended to fill the other Sails. And, with regard to this Point, we do not ſee what human Induſtry can do more; unleſs it were to *ſpread the like kind of low Sails, in the manner of Wings, from the Middle of the Ship; two on both Sides; when the Wind blows fore-right.*

Wing-Sails from the Ship's ſides.

5. In order to prevent the fore-Sails from being robbed by the back-Sails, in fore-right Sailing; there ſeems to be no other Method left, but to range the Sails in the Form of a pair of Steps, mounting upwards from Stern to Stem, ſo that the Sails of the Mizzen-Maſt may hang the loweſt, thoſe of the Main-Maſt in the middle, and thoſe of the Fore-Maſt higheſt; whence one Sail will not hinder, but rather aſſiſt, and ſerve another; by giving and tranſmitting the Wind thereto. But this only holds good in ſailing before the Wind; for in a ſide Wind, all the Sails co-operate. And ſo much for the firſt *Fountain of Impulſe.*

To prevent the Sails from being robbed of their Wind.

6. The ſecond *Fountain of Impulſe* ariſes from the manner wherein the Wind ſtrikes the Sail; for if, thro' the Contraction of the Wind, the

The ſecond Origin; the kind of Stroke.

Stroke be ſharp and ſudden, it will give the greater Motion; but if diffuſed and languid, the leſs.

The Sails to be neither full ſtretched nor looſe.

7. And with regard hereto, 'tis of very great moment that the Sails ſhould receive but a moderate Swell and Extenſion: for if they be too tort, they will rebound the Wind, like a Wall; and if too ſlack, the Impulſe will prove weak.

The Succeſs here not owing to Judgment.

8. And here human Induſtry has ſucceeded in ſome Particulars, tho rather by Chance than by Judgment; for, in a ſide Wind, they contract that part of the Sail, as much as poſſible, which is oppoſite to the Wind; and by this means throw the Wind into the other part, where they would have it blow. And this, indeed, they do by Deſign; tho, perhaps, without conſidering that beſides this, the Wind is at the ſame time neceſſarily contracted; and ſo has a ſharper Percuſſion.

Spur-faſhion'd Sails.

9. What farther Improvement may here be made, we do not well perceive; unleſs the Figure of the Sails were altered; and ſome of them made not to ſwell ſpherical, but Spur-faſhion; with the Yard in the middle of the Bend: ſo that the Wind, being contracted towards a Point, might not only have a ſmarter Percuſſion; but the Sail alſo the better cut the reſiſting Air.

And a Sail within a Sail.

And we know not what might be the Effect of having a Sail within a Sail; that is, to fix a kind of Purſe in the middle of a larger Sail; and keep it aſtrut with ſplices of Wood; ſo as to collect the Wind in the middle of the large Sail, and bring it to a kind of Point.

The third Origin, the place of Percuſſion.

10. The third *Fountain of Impulſe*, proceeds from the Place where the Percuſſion is made; and is of two kinds: for the Impulſe is eaſier and ſtronger on the fore-part, than on the hind-part of the Ship; and on the upper-part of the Maſts and Sails, than on the lower.

Two or three Fore-Maſts.

11. Nor do Men ſeem to have been ignorant hereof; as laying the greateſt ſtreſs upon the Sails of the Fore-Maſt, in ſailing before the Wind; and ſpreading their Main-top-Sails in Calms. And we can think of no farther Improvement, at preſent, in this reſpect; unleſs, as to the *firſt* Caſe, it be to have two or three Fore-Maſts; the middle one erect, and the others inclined, with their Sails hanging right-down; and, in the *ſecond*, to enlarge the Fore-Maſt Sails, at the Top, or to make them leſs tapering than uſual: but, in both Caſes, ſo as to prevent all Danger from ſinking the Ship too much.

III.

Of the Motion of the Wind, in other Machines of human Invention.

The Action of the Wind in turning Wind-Mills.

1. THE Motion of a *Wind-Mill* has no difficulty in it; and yet 'tis, uſually, neither well demonſtrated nor explained. The Sails are ſet directly facing the Wind that blows; but one ſide of each Sail lies more to the Wind, whilſt the other gradually ſlopes away from it. But the revolving Motion always begins from the lower Side; which is farther removed from the Wind. And now the Wind, blowing againſt the Machine,

is compreſs'd by the four Sails; and obliged to take its Courſe thro' the open Spaces between them: whence the Wind, in this compreſſed State, of neceſſity bruſhes ſmartly againſt the Edges of the Sails, and turns them round; as a Top, or the like, is turned, or ſet up, by a Flirt of the Finger.

How the Impulſe is given.

2. If the Sails were ſtretched out equally, 'tis a Queſtion which way they would incline; as in the falling of a Stick: but as the firſt Side that meets the Wind, throws the force of the Wind upon the lower Side; and this again throws it into the Vacuities; this lower Side receives the chief Impulſe of the Wind; whence the Rotation preſently begins on that Part: for 'tis not the firſt Impulſe of the Wind in front[f]; but a lateral Impulſe, after the Compreſſion, that begins the Motion.

Experiments upon altering the Sails of Wind-Mills.

3. To this Purpoſe we made ſeveral Experiments upon Paper-Sails, turned with the Blaſt of Bellows. (1.) And firſt, we added a Fold to the lower Side of the Sail turning away from the Blaſt, which now coming ſideways, might have a larger Surface to ſtrike againſt: but this had no good Effect; the additional Fold not aſſiſting the Percuſſion of the Wind, ſo much as it hinder'd the Sails from cutting the Air. (2.) Next we placed Obſtacles at ſome diſtance behind the Sails, the whole breadth of them all; that the Wind being more compreſſed, might ſtrike the ſtronger: but this rather did harm; as the Repercuſſion checked the primary Motion. (3.) Laſtly, we made the Sails double their former Width, that the Wind might be compreſſed the more; and have a ſtronger lateral Percuſſion: and this ſucceeded extremely; ſo that the Sails turned with a much gentler Blaſt; and revolved with a far greater Velocity.

PRECEPTS.

A Trial of ſix or eight Sails recommended.

(1.) Perhaps this increaſe of Motion may be more commodiouſly procured by ſix or eight Sails, than by four of twice the Breadth; unleſs the Bulk ſhould be too great for the Motion. But of this let Trial be made[t].

Oar-Sails to be tried.

(2.) The Length of the Sails alſo contributes to the Motion: for in all Rotations, a ſmall Force applied towards the Circumference, is equal to a much greater towards the Center. But the lengthening of the Sails has this Inconvenience, that the longer they are, the wider they ſtand from one another a-top; and the leſs the Wind is compreſſed. It might, perhaps, ſucceed, to have the Sail ſomewhat long, and widening towards the Top, like an Oar: but this we have not tried.

ADMONITIONS.

Wind-Mills with large Sails, to be ſtrong built.

(1.) If theſe Experiments be reduced to Practice in Wind-Mills, the whole Machine muſt have Strength in its Structure; eſpecially in its Foundation;

[f] Which directly tends to over-ſet the Mill.

[t] Enquire the Succeſs of a full Circle of Sails, placed Valve-faſhion, for the Wind to ſlip thro'; as in the Wind-Mill at *Deptford-Bridge*, near *London*.

dation: for the more the Wind is compreſſed, tho it whirles the Sails round the faſter; yet it alſo gives the greater Shock to the Mill.

Wind-Coaches. (2.) 'Tis reported, that there are, in certain Places, *Wind-Coaches*, or Caravans, driven with Sails; which is an Affair that ſhould be well enquired into [v].

PRECEPT.

Carriages to be aſſiſted by the Wind. Carriages to move by the Wind are impracticable, except in Plains, and open Places. And even here alſo, what muſt be done when the Wind fails? It is more rational to think of eaſing the Motion of Waggons, and Carriages, by moveable Sails, to take up and down; which might favour the Horſes, and eaſe their Labour; than pretend to drive by Land, with the Wind alone.

SECT. XIV.

Of the Preſages, *or* Prognoſticks of the WINDS; *in proſecution of the fifteenth Article of the* Table of Enquiry.

TRANSITION.

Natural Divination to be cultivated. THE more *Divination* [u] has been corrupted with Vanity and Superſtition; the more the purer part of it ſhould be received and regarded. But *Natural Divination* is ſometimes more, and ſometimes leſs certain; according to the Nature of the Subject whereon 'tis exerciſed: ſo that in a Subject of a conſtant and regular Nature, it affords a true Prediction; but in Things of a various, compounded, and caſual Nature, one that is fallacious. And yet, even in a variable Subject, Predictions will generally hold true, if care be uſed in forming the Rules; or not err greatly, tho it ſhould not hit upon the preciſe Time of Events. But even in point of Time, ſome Predictions will come very near; particularly ſuch as are derived not from *Cauſes*, but from the actual *Beginnings* of Things; tho they manifeſt themſelves ſooner, in a prepared and well-diſpoſed Matter, than otherwiſe. We now, therefore, proceed to the *Prognoſticks of Winds*; wherewith we ſhall neceſſarily intermix ſome others, concerning Rain and fair Weather; which cannot well be ſeparated from the former: but leave the particular Enquiries about them to their own proper *Titles*, and *Hiſtory*.

1. If

[v] Accounts and Deſcriptions of this kind are to be met with in Voyages to the *Eaſtern Countries*; but how far they may be ſafely relied upon, is not certain. And ſuch kind of Contrivances ſeem chiefly uſed in ſandy Deſarts, the Sand here, in ſome meaſure, anſwering to Water; ſo as to make the Motion a kind of Sailing.

[u] See the *Article* DIVINATION, in the *Sylva Sylvarum*.

Predictions of the Wind and Weather, from the Sun.

1. If the Sun appear concave at its riſing, the Day will prove windy; or ſhowry: if the Concavity ſeem ſhallow, windy; but if deep, ſhowry.

2. The Sun riſing pale, or, as we vulgarly expreſs it, watery, denotes Rain; and if it ſet pale, Wind.

3. If the Body of the Sun ſet Blood-red, it foretells great Winds, for many Days.

4. If, at Sun-riſing, his Rays appear fiery, not yellow; it denotes Rain rather than Wind. Underſtand the ſame of his ſetting.

5. If, at the riſing or ſetting of the Sun, his Rays appear contracted, or ſhorten'd, and do not ſhine out bright; tho the Weather be not cloudy; it denotes Rain rather than Wind.

6. If, before Sun-riſing, there appear over-early Rays; it denotes both Wind and Rain.

7. If, at Sun-riſing, the Sun throws his Rays from the Clouds, whilſt one half of his Body remains clouded; it fore-ſhews Rain; eſpecially if thoſe Rays ſtrike downwards, ſo as to ſhew the Sun bearded: but if the Rays break from the middle, or from ſeveral Parts, whilſt the Sun's external Face remains covered with Clouds; it ſignifies great Storms both of Wind and Rain.

8. If the riſing Sun be encompaſſed with a Circle, Wind may be expected from that Quarter where the Circle ſhall open; but if the whole Circle ſhall vaniſh equably, 'tis a ſign of fair Weather.

9. If, towards Sun-ſet, he appears with a white Circle about him, it promiſes a little Storm the ſame Night; but if the Circle be black, or duſky, it portends a great Wind the next Day.

10. The Clouds looking red at Sun-riſing, prognoſticate Wind; but at Sun-ſetting, fair Weather the Day following.

11. When at Sun-riſing Clouds gather themſelves near the Sun's Body; it promiſes a ſevere Storm the ſame Day: but if they fly from the Eaſt to the Weſt, it denotes fair Weather.

12. If, at Sun-riſing, the Clouds diſperſe from about the Sun, ſome to the South and others to the North; tho the Sky ſeems clear near the Sun itſelf; yet this prognoſticates Wind.

13. If the Sun, at ſetting, be wrapt in a Cloud; it denotes Rain the next Day: but if it actually rain at Sun-ſet, it rather denotes Wind; or, if the Clouds ſeem to be drawn towards the Sun, it denotes both Wind and Storms.

14. When the Clouds, at Sun-riſing, ſeem not to encompaſs the Sun, but to hang over him, as if to eclipſe him; this portends Winds to ariſe from that Quarter where the Clouds incline: but happening at Noon, it denotes both Wind and Rain.

15. When Clouds every way block up the Sun, the leſs Light there is left and the ſmaller the Diſk of the Sun appears, the more raging will be the Storm: but if the Sun's Body ſhall appear double, or treble, as if there were two or three Suns, the more ſevere will the Tempeſt prove, and continue for many Days.

16. The

Predictions from the Moon.

16. The New-Moon ſhews the Diſpoſitions of the Air; tho, principally on the fourth Day, when her Newneſs ſeems confirmed: but the Full Moon is a ſtronger Prognoſtick than any of the Days that ſucceed it.

17. By long Obſervation, the fifth Day of the Moon is held ſuſpected, at Sea, for ſtormy.

18. If the New-Moon does not appear till the fourth Day, it prognſtiocates a troubled Air for the whole Month.

19. If the New-Moon, either at her firſt Appearance, or within a few Days after, has her lower Horn obſcure, duſky, or any way ſullied; it denotes foul Weather and Storms, before the Full: but if ſhe be diſcoloured in the middle, Storms are to be expected about the Full; or about the Wane, if her upper Horn be affected in like manner.

20. When the Moon, on her fourth Day, appears pure and ſpotleſs, her Horns unblunted, and neither lying flat nor ſtanding erect, but betwixt both; it promiſes fair Weather, for the greateſt part, till New-Moon again.

21. If at this time ſhe riſes red, it portends Wind; if reddiſh, or duſky, Rain: but it denotes neither beyond the Full.

22. An erect Moon is generally threatning, and unfavourable; but particularly denotes Winds: tho if ſhe appear with ſhort and blunted Horns, it rather denotes Rain.

23. If one Horn of the Moon ſhall be more pointed and erect, and the other more obtuſe; it rather denotes Wind: but if both, it denotes Rain.

Halos.

24. A Circle, or Halo, about the Moon, rather denotes Rain, than Wind; but if ſhe appear erect, within the Circle, it portends both.

25. Circles about the Moon always denote Winds, on that ſide where they break: and a remarkable Brightneſs of the Circle, in any part, denotes Winds from that part.

26. Double or treble Circles about the Moon, portend ſevere and dreadful Tempeſts; and much more, if thoſe Circles are not entire, but broken and ſpotted.

27. The Colours and Halo's attending the Full-Moon, afford nearly the ſame Preſages as the Moon's fourth Day; but the Accompliſhment is more immediate.

Full-Moon.

28. The Full-Moon is generally more attended with fair Weather, than other Ages of the Moon; but ſometimes, in the Winter with intenſe Cold.

29. The Moon appearing larger about Sun-ſet, yet luminous and not duſky, promiſes fair Weather for many Days.

Eclipſes.

30. An Eclipſe of the Moon is commonly attended with Wind; an Eclipſe of the Sun, with fair Weather; and ſeldom either of them with Rain.

Conjunctions of the Planets.

31. Wind is to be expected both before and after the Conjunctions of all the Planets with one another; but fair Weather after their Conjunctions with the Sun.

Riſing of the Conſtellations.

32. Mild Rains and Showers follow upon the riſing of the *Pleiades*, and *Hyades*; but Storms upon the riſing of *Orion*, and *Arcturus* [w].

33. Shooting

[w] See the Note upon § 6. of *Sect.* X. *pag.* 472.

33. Shooting Stars, as they are commonly called, foretel Winds to ariſe ſoon, from that Quarter whence ſuch ſuppoſed Stars darted: but if they fly from ſeveral, and contrary parts; it denotes great Tempeſts, both of Wind and Rain. *Star-ſhoots.*

34. When the ſmall Stars are not viſible, any where in the Sky; it preſages great Storms and Rains, within a few Days: but if theſe ſmall Stars are obſcured in ſome parts, and clear in others, it foretels only Wind; but ſooner. *Small Stars inviſible.*

35. An equably bright Heaven at the New-Moon, or on her fourth Day, preſages fair Weather, for ſeveral Days; when uniformly obſcure, Showers; but when interruptedly obſcure, Winds from that Quarter where the Obſcurity is. And if the Heavens grow dark on a ſudden, without Cloud or Fog to intercept the brightneſs of the Stars; 'tis a Sign that rough and ſevere Storms are at hand. *Obſcurity of the Heavens.*

36. When an entire Circle ſurrounds a Planet, or any large fixed Star, it preſages Rain; but if the Circle be broke, Winds, from that Quarter where the Breach is. *Circles about the Stars.*

37. When it thunders more than lightens, expect great Winds: but if it lightens frequently between the Thunder-Claps, expect haſty Showers, with large Drops. *Thunder.*

38. Thunder in the Morning foreſhews Wind: and in the Afternoon, Showers.

39. Loud Thunder, if it roll and paſs by the Place where 'tis heard, denotes Winds; but that conſiſting of unequal and ſharp Claps, denotes Storms, both of Wind and Rain.

40. If it lightens, and the Sky be clear, Winds and Rain are ſoon to be expected, from the Quarter where the Lightening happens; but if it lightens from different parts of the Sky, ſevere and dreadful Tempeſts are to follow.

41. When it lightens from the cold Quarters of the Heavens, as the North and North-Eaſt; Hail uſually follows: but if from the warmer, as the South and Weſt, ſultry Showers. *Lightning from different Points.*

42. Great Heats, after the Summer's Solſtice, generally end in Thunder and Lightning; or, if theſe ſucceed not, terminate in Wind and Rain, that laſt for many Days. *Great Heats.*

43. The fiery Ball which is ſeen at Sea, and called *Caſtor* by the Ancients, if it be ſingle, prognoſticates a ſevere Tempeſt; and ſo much the more, if it does not adhere to the Maſt of the Ship, but rolls or dances about: but if there appear two of them, or both *Caſtor* and *Pollux*, together, when the Storm is grown ſtrong, this is reckoned a good Sign; but if there be three of them, or *Helena* alſo attending, the Tempeſt becomes more outrageous: ſo that the Appearance of one alone, denotes Crudity in the tempeſtuous Matter; two a Concoction or Ripeneſs thereof; but three or more, ſuch a large Collection as is diſſipated with difficulty. *From the Brothers at Sea.*

44. If the Clouds drive faſt whilſt the Sky is clear, let Winds be expected from that Quarter whereto the Clouds are driven; but if they collect and roll up together, they will afterwards begin to ſeparate and diſperſe, *From the Clouds.*

when the Sun approaches to that Part where they are collected: and if they diſperſe more towards the North, it denotes Wind; but if to the South, Rain.

45. The Clouds riſing black or duſky at the ſetting of the Sun, denotes Rain the ſame Night, if they riſe oppoſite to the Sun, or in the Eaſt; but the next Day, attended with Wind, if they riſe near the Sun, or from the Weſt.

46. The Sky clearing up, or the Clouds breaking away into a Part oppoſite to the Wind that blows, denotes fair Weather; but clearing up towards the Wind, it yields no certain Prognoſtick.

47. Sometimes there are ſeveral Floors, or Stories of Clouds, one above another; five whereof Dr. *Gilbert* declares, he has ſometimes obſerved at once: but the lower are always blackeſt; tho it may ſometimes appear otherwiſe; becauſe the whiter ſtrike the Sight moſt. A double Range of them, if thick, denotes approaching Rain; eſpecially if the lower Cloud ſeem ſwoln: and more Floorings denote the continuance of Rain from Day to Day.

48. When the Clouds appear fleecy, and are diſperſed up and down the Sky, they denote Storms; but if they appear to wrap over one another, like Scales, or the Tiling of a Houſe, they promiſe dry and fair Weather.

49. Feathered Clouds, or ſuch as appear like the Branches of the *Palm-Tree*, or the *Flower-de-luce*; denote Showers at hand, or not far off.

50. When Hills and Mountains appear, as it were, with their Caps on, from the Clouds that hang about and ſurround them; 'tis a Sign of impending Storms.

51. Clouds appearing of an Amber or Gold Colour, before Sun-ſet; and having, as it were, their Edges gilt with Gold; promiſe fair Weather, after the Sun is gone down lower.

52. Clouds that appear muddy and dirty, prognoſticate Rain and Wind at hand.

53. The ſudden Appearance of a light Cloud, in a clear Sky; eſpecially coming from the Weſt, or about the South; denotes a Storm a-brewing.

54. The Appearance of a white pregnant Cloud, called by the Ancients a *white Tempeſt*; denotes ſmall Hail in the Summer, and Snow in the Winter.

From Miſts. 55. When Miſts and Fogs riſe upwards, they denote Rain; if they mount ſuddenly, as if they were ſucked up, they foreſhew Winds; but when they fall, and remain in the Vallies, fair Weather.

56. A ſerene Autumn denotes a windy Winter; a windy Winter, a rainy Spring; a rainy Spring, a ſerene Summer; a ſerene Summer, a windy Autumn: So that the Air, upon a Balance, is ſeldom Debtor to itſelf. Nor do the Seaſons ſucceed each other, in the ſame Tenor, for two Years together.

The burning of Fire and Candles. 57. When our common Fires burn paler than uſual, and murmur or reſound within, 'tis a Sign of a Storm; if the Flame, curls, bends, and waves in its riſing, it principally denotes Wind; but ſpongy Excreſcences in the Snuffs of Candles and Lamps, rather denote Rain.

58. When Coals burn bright and ſhining, 'tis a Sign of Wind; ſo, likewiſe, when they quickly depoſite and throw off their Aſhes.

59. When the Sea appears calm on its Surface from the Land, and yet has a murmuring Noiſe, tho without ſwelling; this foretels Wind. *From the Sea.*

60. The ſounding of the Shores in a Calm, and the ringing of the Sea itſelf, with a certain Flutter, or kind of Echo, heard more diſtinctly, and to a greater diſtance than uſual, prognoſticates Winds.

61. The Appearance of Froth, white Crowns, or Bubbles of Water up and down, on the Surface of the Sea, whilſt it lies flat and calm, denotes Winds; and when theſe Signs are more remarkable, ſevere Tempeſts.

62. The Appearance of a ſhining Froth, called Sea-Lungs, upon a rough and turbulent Sea, denotes a Continuance of the Tempeſt for many Days.

63. When the Sea ſwells without Noiſe, and riſes to the Shore higher than uſual; or if the Tide comes in freſher than ordinary; this prognoſticates Winds. *Tide.*

64. A Sound coming from high Hills, and a murmuring Noiſe riſing in Woods, as alſo a kind of Crackling in open Places, foretels Winds: ſo likewiſe an unuſual Murmuring in the Heavens, without Thunder, principally denotes Winds. *From Hills and Woods.*

65. Leaves and Chaff playing in the Air, without any ſenſible Breeze; the Downe of Plants flying about; and Feathers floating and playing upon the Waters; denote Winds at hand. *Light Matters playing.*

66. Water-Fowl flying and flocking together; but particularly Mews, Gulls, and Moor-Hens, quitting the Sea or Rivers, and haſtening to the Shores or Banks, eſpecially if with a Cry; and again, their playing on the dry Land, foretels Winds; eſpecially if this happen in the Morning. *Water-Fowl.*

67. On the contrary; when Land-Fowl go to the Water, ſtrike it with their Wings, waſh themſelves, and raiſe their Cry; but eſpecially the Crow; this portends Tempeſts. *Land-Fowl.*

68. Ducks and Coots, or Didappers, are obſerved to prune their Feathers before Wind; but Geeſe with their importunate Gaggle, ſeem to call down Rain. *Ducks, Geeſe, &c.*

69. When the Heron tours upright, ſo as ſometimes to fly above a low Cloud; this denotes Wind: but the high Flight of a Kite denotes fair Weather. *The Heron and Kite.*

70. The continued Croaking of the Raven, in a ſobbing manner, preſages Wind; but if it be by Fits, in a ſtifled manner; or if the Croak be repeated at longer Intervals, it denotes Rain. *Raven.*

71. The Whooping of the Owl was thought, by the Antients, to denote a change of Weather, from fair to Rain, or from cloudy to fair: but with us, if the Owl whoops free and clear, it generally denotes fair Weather; eſpecially in Winter. *Owl.*

72. If the Birds which rooſt on Trees fly early to their Neſt, and quit their Feeding ſoon, it preſages Storms; but when the Heron ſtands melancholy upon the Sand, or the Raven ſtalks about, it denotes only Rain. *Birds flying early to their Neſts.*

Dolphins. 73. When Dolphins play in a Calm at Sea, this is thought to foretel Wind from that Quarter whence the Dolphins come; on the contrary, their playing, and throwing the Water about, in a rough Sea, denotes fair Weather: but for moſt other Kinds of Fiſh; their ſwimming a-top, and ſometimes leaping out of the Water, denotes Rain.

Hogs. 74. Hogs are ſo diſturbed, affrighted, and ſtrangely affected at the riſing of Wind, that the Country People have a Notion, this is the only Creature that can ſee the Wind; and imagine it a frightful Sight.

Spiders. 75. Spiders ply their Work hard before Wind; as if they ſnatched the Opportunity of ſpinning their Webs, before the Wind ſhould come to prevent them.

Sounds. 76. The ringing of Bells is heard to a greater diſtance before Rain; but before Wind more unequally: the Sound coming and going, as it does when the Wind blows ſtrong.

Trefoil. 77. *Pliny* delivers it as certain, that Trefoil briſtles and pricks up its Leaves againſt a Storm.

Meats ſweating. 78. He likewiſe adds, that Veſſels containing Eatables, will ſometimes leave a Sweat behind them in the Buttery where they ſtood; and that this prognoſticates ſevere Tempeſts.

ADMONITION.

The Hiſtory of Rain to be conſulted. Since Rain and Winds have nearly the ſame common Matter; and ſince ſome Condenſation of the Air always precedes Wind; becauſe the new-made Air is received within the old; as appears by the ringing of the Shores, *&c.* the high flight of the Heron, *&c.* and ſince, in like manner, a Condenſation of the Air always precedes Rain; it follows, that Rain muſt have many Prognoſticks in common with Wind; for which, the Prognoſticks of Rain, ſhould be conſulted under *the particular Hiſtory of that Meteor* [x].

SECT. XV.

Of Imitating the WINDS; *in regard to the ſixteenth Article of the* Table of Enquiry.

TRANSITION.

Mens manner of enquiring too confined. IF Men could but perſuade themſelves, not to pin their Minds down to the ſole Conſideration of the Subject they propoſe; ſo as to forget every thing elſe, as little to the Purpoſe; which they ſubtilize and ſpeculate for ever upon it, as they generally do, in a fruitleſs manner; they could not be ſo ſtupefied

[x] But this *Hiſtory* is not hitherto extant, that we know of. If proper Hiſtories of all the Meteors were wrote, tho it were in no greater Perfection than the preſent *Hiſtory of Winds*, they might afford much Light to one another.

ſtupefied as they commonly appear; but would transfer their Thoughts, and, by reaſoning, diſcover many Things at a diſtance, which lay hid nearer hand. It were, therefore, proper to transfer the Method and Conduct obſerved in the *Law*, to the *Law of Nature*; and proceed in natural Enquiries with the ſame Sagacity and Reaſoning, from Parallels and Similitudes, as we practice in Law-Caſes [y].

1. Bellows, with Men, are the Store-Veſſels of Wind; from whence we derive it, in Proportion to our Wants and Abilities. The Vallies and Interſtices of Mountains, and the open Windings and Turnings betwixt Buildings, are but larger kinds of Bellows. The principal Uſes of Bellows, are the animating of Fire; and blowing the Organ. They act by drawing in the Air, to prevent a *Vacuum*, as the Phraſe is; and driving it out again by Compreſſion. *The Uſe and Action of Bellows.*

2. We likewiſe uſe Hand-Fans for Coolneſs, and the making a Wind. Theſe impel the Air but gently [z]. *Fans.*

3. We have already mentioned a Method of making Rooms cool in Summer [a]; but more curious and exact Ways may be diſcovered, eſpecially if, in the manner of Bellows, the Air was drawn in at one part, and diſcharged at another. But the Methods at preſent in uſe for this Purpoſe, turn only upon Compreſſion. *Cool Rooms.*

4. There is a great Agreement between the Winds of the World, and the Flatulencies in the Body of Man, and other Animals: for theſe alſo are generated from Moiſture, and alter with it; as Winds and Rains do. They are alſo diſſipated, and made to perſpire, by a ſtronger Heat. And hence an Obſervation may be transfered to the Winds; *viz.* their being produced from a Matter affording a tenacious Vapour, that is not eaſily diſſipated; as we find by Beans, Pulſe and Fruit; which proves the Caſe alſo in the greater Winds. *Agreement between Winds and Flatulencies in the Body.*

5. In the Diſtillation of Vitriol, and other Foſſils, which are flatulent and exploſive, they are obliged to uſe large Receivers, to prevent their being broke [b]. *Wind generated in Diſtillations.*

6. The Wind made by the Nitre in Gunpowder, burſting out of a ſudden, and blowing the Flame along, not only equals, but exceeds all other Winds; excepting thoſe of Thunder. *By Gunpowder.*

7. The

[y] Let the preſent Hiſtory ſerve for an Example; wherein all Nature and Art ſeems to have been ſearched, with a View to the Subject; and Matters brought in for it from every Quarter. When all the Materials belonging to the Subject are thus found, collected, and ranged in their propereſt Order, ſo as to afford a perfect Set of Tables, with their *Axioms*; and fully exhibit the Thing as it is in Nature; then will the Enquiry be finiſhed, and not before. See the *Novum Organum*. Part II.

[z] Add here the common Method of Winnowing by the Wheel-Fan; ſhooting with the Wind-Gun, *&c.*

[a] See *Sect.* VIII. *Accidental Generations of Winds.*

[b] Here enumerate the Bodies that generate moſt Air by Diſtillation; *viz. Tartar, Tallow*, &c. See Mr. *Hales's Vegetable Staticks.*

7. The Force of the Wind is compreſſed in Machines, and Engines of human Invention; as in Guns, Mines, and Powder-Houſes, when they fire and blow up; but it has not hitherto been experienced, whether if a large Quantity of Gun-powder were fired in the open Air 'twould raiſe a Wind, by the Commotion of the Air, that ſhould laſt ſeveral Hours [c].

By Mercury and Gold.

8. There is a flatulent and expanſive Spirit concealed in Quickſilver; ſo as to make it, in effect, reſemble Gunpowder: and a little of it mixed along with Gunpowder, makes the Powder ſtronger. The Chemiſts alſo ſpeak of Gold, as if in ſome ways of preparing, it would make an Exploſion, almoſt like Thunder [d].

A larger OBSERVATION.

The Motion of the Winds ſeen by that of the Water.

The Motion of the Winds is, in many Reſpects, ſeen, as in a Glaſs, by the Motion of the Waters. (1.) Great Winds are Inundations of the Air, like Inundations of the Water; both proceeding from an Increaſe of Quantity. (2.) As Waters either deſcend from above, or flow from the Earth; ſo ſome Winds are thrown down from on high, and ſome riſe up from below. (3.) As ſometimes in Rivers there are contrary Motions, one Motion of the Tide, another of the River's Courſe; and yet but a ſingle Motion takes place; that of the Tide becoming predominant: ſo, likewiſe, when contrary Winds blow, the greater ſubdues the leſs. (4.) As it ſometimes happens in Currents of the Sea, and certain Rivers, that the Water a-top moves in a contrary Direction to that below; ſo, likewiſe, in the Air, when contrary Winds blow, together, the one flies over the other. (5.) As there are Cataracts of Rain falling within a narrow compaſs; ſo there are, in like manner, narrow Eddies of Wind, or Whirlwinds. (6.) As Waters, when diſturbed, will have an Undulation, beſides their progreſſive Motion; ſo likewiſe have the Winds. And beſides theſe, there are other Correſpondences between them, derivable from the preſent Enquiry.

SECT. XVI.

Imperfect AXIOMS; *or* Variable CANONS, *formed upon the* preceding Enquiry.

TRANSITION.

CANONS, or AXIOMS, are either *particular* or *general*; but both of them with us are variable or improvable: for we dare not yet pronounce upon any thing. As to *particular Axioms*, they may be deduced and collected

[c] As the firing of great Guns is ſaid to allay Storms.
[d] This ſeems meant of the *Aurum Fulminans*.

collected from almoſt every *Article*; but we ſhall here ſubjoin a few of the *general ones*, that we have ourſelves drawn out[e].

AXIOM I.

1. *Wind is nothing more than Air put into Motion, either by a ſimple Impulſe, or the Admixture of Vapours.* *The Nature of Wind.*

AXIOM II.

2. *Winds are produced by the ſimple Impulſe of the Air, four Ways*; viz. (1.) *By the natural Motion of the Air*; (2.) *by the Expanſion of the Air in the Path of the Sun*; (3.) *the Contraction of the Air by ſudden Cold*; *and*, (4.) *by the Compreſſion of the Air from external Bodies.* *Winds produced by four Impulſes.*

There may poſſibly be a *fifth Way*; *viz.* by the Agitation and Concuſſion of the Air from the Stars: but Operations of this kind ſhould not be mentioned yet[f]; or elſe ſhould be but ſparingly received.

AXIOM III.

3. *The principal* Cauſe *of Winds, produced by the Admixture of Vapours, is, the Air's being over-loaded by the Air newly formed from Vapours; whence the Bulk of the Air increaſes, and requires more room.* *The principal Cauſe of vaporous Winds.*

AXIOM IV.

4. *A ſmall, freſh Supply of Air may cauſe a great Swell, every way, in the Atmoſphere; ſo that this new Air, from the Reſolution of Vapours, contributes more to the Motion than the Matter: but the great Body of the Wind conſiſts of the former Air. And the new Air does not drive the old Air before it, as if they were ſeparate Bodies; but both being mixed together, they require a larger Space.* *A ſmall Supply of Air, may prove a great Cauſe of Wind.*

AXIOM V.

5. *When there is another Principle of Motion beſides the Surcharge of the Air; this proves an Acceſſory, that increaſes and ſtrengthens the Principal: whence it is, that great and boiſterous Winds ſeldom ariſe from a bare Surcharge of the Air.* *Violent Winds ſeldom proceed from a bare Surcharge of Air.*

AXIOM VI.

6. *There are four Acceſſories to the Surcharge of the Air*; viz. (1.) *Subterraneal Expirations*; (2.) *Precipitation from that called the Middle Region of the* *Four Acceſſories to the Surcharge of the Air.*

[e] See *Novum Organum*, Part II. *Aph.* V.

[f] Till better known and diſcovered; or till Natural Philoſophy itſelf is farther advanced.

the Air; (3.) *Diſſipation of formed Clouds*; *and*, (4.) *Mobility and Acrimony of the Exhalation itſelf.*

AXIOM VII.

The Motion of the Wind generally lateral.

7. *The Motion of the Wind is almoſt conſtantly lateral: that which proceeds from the ſimple Surcharge of the Air, is ſo from the firſt*; *and that which proceeds from ſubterraneous Expirations, or Repercuſſion from above, becomes ſo ſoon after*; *unleſs when the Eruption, Precipitation, or Reverberation, are exceedingly violent.*

AXIOM VIII.

Winds denſer than Air.

8. *Air will ſuſtain ſome Compreſſure before it becomes ſenſible of being overloaded, or before it will impel the Air contiguous to it*; *whence it is, that all Winds are ſomewhat more denſe than Air at reſt.*

AXIOM IX.

Winds laid five Ways.

9. *Winds are allay'd five Ways*; viz. (1.) *When the Vapours come together*; (2.) *incorporate*; (3.) *ſublime*; (4.) *tranſport*; *or*, (5.) *ſpend themſelves.*

AXIOM X.

Rain formed four Ways.

10. *Vapours come together, or the Atmoſphere forms itſelf into Rain, four Ways*; viz. (1.) *By being oppreſſed with Quantity*; (2.) *condenſed by Cold*; (3.) *by contrary Winds driving the Vapours together*; *and*, (4.) *by reverberating Obſtacles.*

AXIOM XI.

Vapours and Exhalations the Matter of Winds.

11. *Both Vapours and Exhalations afford Matter of Winds: for tho Rain never proceeds from Exhalations*; *yet Winds may frequently proceed from Vapours. But there is this Difference, that the Winds made from Vapours more eaſily incorporate with pure Air, become ſooner appeaſed, and prove not ſo ſtubborn, as thoſe from Exhalations.*

AXIOM XII.

Heat has a Power to produce Wind.

12. *The Modification and different States of Heat, have as great an Effect in the Production of Winds, as the Quantity or Conditions of the Matter.*

AXIOM XIII.

The degree of Heat required to produce Winds.

13. *In the Generation of Winds, the Sun's Heat ſhould be ſo proportionate as to excite them*; *but not ſo plentifully as to make them collect into Rain*; *nor yet ſo ſparingly as to make them totally diſperſe and diſſipate.*

AXIOM

AXIOM XIV.

14. *Winds blow from the Quarters of their Nurſeries: and when theſe Nurſeries are differently ſeated, different Winds generally blow together; but the ſtronger either ſubdues the weaker, or turns it into its own Current.*

The manner wherein Winds blow.

AXIOM XV.

15. *Winds are generated all the way up, from the Surface of the Earth to the cold Region of the Air: but thoſe that blow oftenеſt, are generated near hand; and the ſtronger above.*

Winds generated thro' the whole height of the Atmoſphere.

AXIOM XVI.

16. *The Countries which have their Serving-Winds warm, are hotter; and thoſe that have them cool, are colder; than in proportion to the Climate.*

Serving Winds cool or warm, according to the Country.

SECT. XVII.

A Table of Particulars *more immediately ſerviceable to* Mankind: *or* DESIDERATA *with their* APPROXIMATIONS; *drawn from the* preceding Enquiry.

DESIDERATUM I.

A Method of forming and diſpoſing the Sails of Ships, ſo as with a leſs Wind to make more way: a Thing of great Uſe for ſhortning Voyages, and leſſening their Expence.

More advantageous Ships and Wind-Mills.

APPROXIMATION.

No Diſcovery has hitherto been made to anſwer this *Deſideratum* preciſely in practice; but conſult the *larger Obſervations* under *Section* XIII.

DESIDERATUM II.

To conſtruct Wind-Mills, and their Sails, ſo as that they may perform more Work with leſs Wind: which alſo is a Matter of Advantage.

APPROXIMATION.

Conſult upon this Head our Experiments under *Section* XIII.

DESIDERATUM III.

To predict the Winds. *A Method of predicting the Rising, Falling, and Times of the Winds: a Thing of use in* Navigation, *and* Agriculture; *but especially in chusing the Times for Sea-Fights.*

APPROXIMATION.

There are many Things to this Purpose in the *preceding Enquiry*, especially under *Section* XIV. But the Observations of Posterity, now the *Cause* of Winds is explained, may afford much more exact Prognosticks.

DESIDERATUM IV.

To predict Discoveries of new Countries. *A Method of prognosticating, and forming Judgment, upon other Things, from the Winds: for Example, whether there be any other unknown Continents, or Islands in the Sea of any Place; or whether the Sea be open and uninterrupted: a Thing of Use in Navigation; and the Discovery of new Countries.*

APPROXIMATION.

The Approximation here, is the Observation of Stated Winds; which seems to have been used by *Columbus*.

DESIDERATUM V.

To predict Plenty and Scarcity. *A Method of predicting the Plenty or Scarcity of Fruits, and Corn, every Year: which would be Matter of Profit, and regulate Bargains and Sales for Time*; as *Thales*, from a natural Divination of this kind, is said to have bought up all the Olives of his Country.

APPROXIMATION.

There are some Things to this Purpose under *Section* VI.

DESIDERATUM VI.

To predict Sickness, &c. *So likewise it would be an useful Thing, and for the Reputation of Physicians, to predict the Diseases and Pestilences of each Year; if this could be done: as also, for discovering the* Causes *and* Cures *of Distempers; with some other Affairs of political Consideration*[k].

APPROXI-

[k] See the Author's *New Atlantis ad finem.*

APPROXIMATION.

And with regard to this, alſo, there are certain Particulars in the preſent Enquiry, eſpecially under *Section* VI.

ADMONITION.

In the Buſineſs of predicting Plenty or Scarcity of Corn and Fruits, and the Riſe of Diſtempers by the Winds; let the Hiſtories of *Agriculture* and *Medicine* be conſulted [1]. *The Hiſtory of Agriculture and Medicine to be conſulted.*

DESIDERATUM VII.

A Method of raiſing and laying the Winds. *To raiſe and allay the Winds.*

APPROXIMATION.

There are certain ſuperſtitious and magical Relations, with regard to this Matter, not worthy to be received into a ſerious and rigid *Natural Hiſtory*; nor can we, at preſent, think of an *Approximation.* However, with a View thereto, let the Nature of the Air be throughly ſifted and examined; to try whether any thing may be found, that when communicated in a ſmall Quantity to it, may excite and multiply Motion; ſo as to dilate and contract the Body of the Air: for if this could be done, the raiſing and laying of the Winds would follow of courſe; after the manner of *Pliny*'s Experiment, if true, of playing Vinegar into a Whirlwind. Another Attempt might be made, by letting out the Winds from ſubterraneal Places; if any were plentifully collected therein; as is currently reported of the Pit in *Dalmatia:* but it will be difficut to diſcover the Places wherein Winds are thus impriſoned.

DESIDERATUM VIII.

Ways of producing many ſurprizing and diverting Phænomena, by the Motion of the Winds. *To produce ſtrange Appearances by Wind.*

APPROXIMATION.

But of the Methods for affecting this, we have no leiſure to conſider. The *Approximation* is the common Way of fighting Battles by

[1] See above, the *Admonition* at the cloſe of *Sect.* XIV.

the Wind [m]. And, doubtleſs, many agreeable Things of this kind might be invented; both with regard to Motion and Sound [n].

[m] This is alſo mentioned under the thirteenth Article of the *Table of Enquiry*. I ſuppoſe the Author means the School-Boys Diverſion of fighting Battles, by the flying of Paper-Kites.

[n] See the *Sylva Sylvarum*, under the Article SOUND. In order to proſecute the Enquiry, it might be proper to conſult, all that relates to it in the *Philoſophical Tranſactions*; *French Memoirs*; and *German Ephemerides*; Sir *Iſaac Newton*'s *Principia*; Mr. *Boyle*'s *Philoſophical Works*; *Stahl*'s *Obſervatio Meteorologia Cokio-Sluteriana*; *Boerhaave*'s four *Chapters* upon the Elements, in his *Chemiſtry*; *Honoratus Faber*, &c. But ſome of the principal Matters here required, ſeem not hitherto received into Books; and muſt be derived immediately from *Nature*, the common *Practical Arts* or new *Experiments*, purpoſely made to give farther Light, and Information, in this Subject.

End of the Hiſtory of WINDS.

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A

PLAN

For the PARTICULAR

HISTORY

OF

Condenſation and *Rarifaction*,

IN

NATURAL BODIES.

BRITISH MUSEUM

PREFACE.

THIS *is a poſthumous Piece, and publiſhed in the original* Latin, *with conſiderable Care, by the Author's Chaplain and Amanuenſis,* Dr. Rawley; *that being a very imperfect* Edition *given of it by* Gruter. *It is one of the Six Hiſtories which the Author deſigned to write monthly. Three of theſe monthly Productions are extant*; viz. The Hiſtory of Life and Death; Winds; *and the* preſent *Hiſtory of* Rarity and Denſity. *But thoſe of* Sympathy and Antipathy; *the* Three Chemical Principles; *and of* Gravity and Levity; *were not publiſhed. Nor does there appear to be any thing hitherto written that may ſupply the Want of them. But the Original, from whence they were to be copied, is* Nature; *which we have always before us.*

The Subject of Rarifaction *and* Condenſation, *has indeed been laudably proſecuted by the Moderns; eſpecially ſince the Invention of the* Air-Pump, *and other pneumatical and hydroſtatical Engines and Inſtruments. Yet it does not ſeem to have been purſued in all that Variety and Fullneſs, wherein it is here ſketched out by the Author.*

An unſeaſonable Indulgence of mathematical Speculations, *ſeems to have ſomewhat diverted the Purſuit: for the Thing appears of late, to have been rather* mathematically *than* phyſically *conſidered. So that we have had Worlds made in the Imagination, by the ſuppoſed Rarifaction of ſingle Particles of Matter; and many other ſuch mathematical Levities, or Sports of Fancy; whilſt the full Proceſs and Uſe of* Rarifaction, *and* Condenſation, *in the real World, has been leſs attended to than it deſerves. For, doubtleſs, a thorough Knowledge of this Subject would lead to a Diſcovery of many* Arts *and* Works; *an Inſtance whereof we have lately had in the*

the Diſcovery of that noble Engine, for Raiſing Water by Rarifaction, *and* Condenſation.

It may, perhaps, appear ſurprizing, to thoſe who ſhall diligently peruſe the following Piece, that the Author ſhould have ſeen ſo far into the modern Phyſicks; *and himſelf have here laid, not only the Foundations of our preſent* Hydroſtaticks, *and* Pneumaticks, *but alſo of much greater Diſcoveries.*

INTRO-

INTRODUCTION.

NO wonder if Nature remain Debtor to Philoſophy and the Sciences, when ſhe has never yet been ſummoned to an Account. For there has hitherto been no careful and regular Enquiry, no exact or tolerable Eſtimate made, as to the Sum or Quantity of Matter in Nature; nor any Notice taken how it is diſpoſed, and laid out upon Bodies. 'Tis a juſt *Axiom*, *That nothing can be detracted from, or added to the Sum total of the Univerſe.* And ſome, indeed, have handled the *Common-place*, how Bodies may be relaxed and contracted, in reſpect of more and leſs, without admitting a *Vacuum* between: but for the Nature of *Condenſation* and *Rarifaction*, one attributes it to a greater and leſs Quantity of Matter; another eludes the Point; whilſt the Generality, following their Author[a], think to diſcuſs and ſettle the whole Matter by that trifling Diſtinction of *Act* and *Power*. And even they who attribute *Condenſation* and *Rarifaction* to the different Quantities of Matter, which is the true Notion, and do not totally deprive the *Materia prima* of Quantity; tho, for other Forms, they require it to be indifferent, yet here end their Enquiry, and look no farther; without perceiving the Conſequence: thus ſlightly paſſing over, or at beſt not fully purſuing, a Conſideration which regards infinite Particulars; and is, in a manner, the Foundation of all *Natural Philoſophy*.

To proceed, therefore, upon what has been juſtly laid down in all the Tranſmutations of Bodies; Matter can never be annihilated; but it requires the ſame omnipotent Power to annihilate, as to create out of Nothing; neither of which ever happens in the Courſe of Nature; ſo that the original Quantity of Matter remains for ever the ſame, without Addition or Diminution. And that this original Stock of Matter is differently portioned out among Bodies, cannot be doubted; for it were Madneſs, by abſtract Subtilties, to pretend, that one Hogſhead contains as much Water as ten Hogſheads of Water; or, that one Hogſhead of Air contains as much as ten Hogſheads of Air. But tho it be admitted, that the Quantity of Matter riſes in proportion to Meaſure, in the ſame Body; this is ſtill queſtioned in Bodies of different Kinds. But if it be demonſtrated, that one Hogſhead of Water turned into Air, will make ten Hogſheads of

[a] *Viz.* Ariſtotle.

Air (and it may rather be proved to make a hundred) there is an end of the Diſpute; for, in this caſe, the Water and the Air are the ſame Body; now contained in ten Hogſheads, tho before it was contained in one. And therefore to aſſert, that one whole Hogſhead of Water may be converted into but one whole Hogſhead of Air, is, in effect, to aſſert that Something may be reduced to nothing: for, in this caſe, one tenth Part of the Water is ſufficient; and the other nine Parts muſt then be annihilated. So, on the contrary, to aſſert that a Hogſhead of Air is convertible into a Hogſhead of Water; is to aſſert, that Something may be created out of Nothing: for the Hogſhead of Air will make but the tenth Part of a Hogſhead of Water; and therefore the other nine Parts muſt be produced from nothing.

We ſhall, however, ingenuouſly confeſs it a difficult Taſk, to ſettle and aſcertain the exact Proportions and Quantities of Matter, contained in different Bodies; and to ſhew, by what Induſtry and Sagacity a true Information may be had thereof: tho the great and extenſive Uſefulneſs of the Enquiry may abundantly reward the Pains that ſhall be beſtowed upon it. For to underſtand the Denſity, and the Rarity of Bodies, and much more, how to procure and effect their Condenſation and Rarifaction; is a Thing of the utmoſt Importance, both in ſpeculative, and practical Philoſophy. Therefore, as the Enquiry is, perhaps, of all others, the moſt fundamental and univerſal; we ſhould come to it well prepared: for all *Natural Philoſophy* is a perfectly looſe and untwiſted Thing without it [b].

[b] The Author keeps to his original Deſign of enquiring into ſuch Subjects firſt, as are either moſt uſeful in themſelves, or moſt fundamental, and leading to others. See *Page* 8——16. of the preſent Volume.

A

PLAN

For the PARTICULAL

HISTORY

OF

Condenſation and *Rarifaction*, &c.

SECT. I.

A TABLE of Enquiry *for the particular Hiſtory of* DENSITY *and* RARITY *in Natural Bodies.*

ARTICLE I.

Tables of Rarifaction and Condenſation.

DIRECTION.

1. LET a *Table* be formed, from particular Experiments, to ſhew by Inſpection, the ſpecifick Gravities, or different Weights of all tangible Bodies, under equal Dimenſions; with relation to *Gold*: and explain the Conſtruction, Nature, and Uſes of this Table.

2. Let *Tables* alſo be formed of Bodies, under the ſame Dimenſions, whole, and in powder; crude and diſtilled; as alſo of *pneumatical Bodies*, according to their Degrees of Expanſion. The whole of this to regard the Expanſion of Matter in Bodies; according to their different Conſiſtencies, whilſt at reſt.

ARTICLE II.

The Dilatations caused by simple Introsusception; or the Admission of one Body into the Pores of another.

DIRECTION.

3. If possible, let the Enquiry be here diligently prosecuted about the Appetites and Motions of Bodies, whereby they swell and sink, rarify and condense, dilate and contract, *&c.* because this is of great Use; as, at once, serving to disclose, and govern Nature. And yet it must proceed summarily; because the Subject of *Density* and *Rarity* is so copious and general, that, if fully prosecuted, it would anticipate many of the following *Titles*; which should not be allowed of.

ARTICLE III.

Dilatation of the innate Spirit, expanding itself.

DIRECTION.

4. Let the Enquiry pass on to the Dilatations and Tumefactions of Bodies; caused by their own internal Spirit; whether naturally, or preternaturally; but without Fire, or manifest external Heat.

ARTICLE IV.

The Dilatations and Relaxations of Bodies, by means of actual, simple, external Heat.

DIRECTION.

5. This Enquiry properly belongs to the Subjects of Heat and Cold, Dilatation, Separation, and Alteration; yet some Knowledge of the Relaxations of Bodies by Fire is here necessary, for the more commodious carrying on of the Enquiry into Condensation and Rarifaction. Let this therefore, be touched only as in Passage.

ARTICLE V.

Dilatations by external Heat in Distillations.

DIRECTION.

6. The Enquiry should next proceed to the Dilatations and Relaxations of Bodies by Heat in Distillations; which affords a better Opportunity, than Coction or Calcination, of discovering the exact Process of this kind of Relaxation: but as the Prosecution hereof properly belongs to the *Title* of Heat and Cold, and the Motion of Dilatation and Separation; it should

ſhould be ſparingly touched under the preſent *Article*, tho it were otherwiſe uſeful to dwell thereon.

ARTICLE VI.

The Dilatations and Relaxations of Bodies by the Remiſſion of Cold.

DIRECTION.

7. Let the Enquiry next proceed to the Dilatations and Relaxations of Bodies, upon the remiſſion of violent Cold; or a leſs comparative degree of Heat; as in Thawing, *&c.*

ARTICLE VII.

The Dilatation and Relaxation of Bodies by potential Heat; or the auxiliary Spirits of other Bodies.

DIRECTION.

8. From the Dilatations made by external Heat, and the remiſſion of Cold; proceed to thoſe made by potential Heat; or the aſſiſting Spirits of another Body applied. And as for the Buſineſs of *potential Heat*, it is proper to conſult the *medicinal Tables* of ſecondary Qualities; from thence to collect the Things that ſeparate by Dilatation in the human Body.

ARTICLE VIII.

The Dilatation of Bodies by a Releaſement of their Spirit.

DIRECTION.

9. Next proceed to the Dilatation of Bodies made by a Releaſement of their Spirits; upon breaking the Priſons of the groſſer Parts, which cloſely detained them; ſo that they could not dilate themſelves.

ARTICLE IX.

The Dilatation happening upon the meeting and uniting of Bodies related.

DIRECTION.

10. This kind of Dilatation is, in ſome caſes, called *Diſſolution*; tho it happens without any manifeſt Tumult. Enquire out the Inſtances hereof.

ARTICLE X.

The Dilatation by Aſſimilation; or the Converſion of a groſſer Matter to ſuch as is more ſubtile.

DIRECTION.

11. This is underſtood of an actual Converſion of one Body into the Subſtance of another: the more eminent Inſtances whereof are to be carefully collected.

ARTICLE XI.

Dilatations or Diſtractions, by external Force.

DIRECTION.

12. Theſe Dilatations or Diſtractions, are ſuch as proceed not from any Appetite in the dilated Body; but from the Violence of a Body external; which prevailing, obliges the other to dilate.

ARTICLE XII.

Dilatations by Diffuſion; or Spreading.

DIRECTION.

13. This being a ſpurious kind of Dilatation it need not be here very particularly enquired into: Tho the more eminent Inſtances ſhould be enumerated; as the Ductility of Gold, *&c.*

ARTICLE XIII.

Contractions by the emiſſion, or diſcharge, of a Body received.

DIRECTION.

14. Having thus proſecuted the Buſineſs of *Dilatations*, *Rarifactions*, and *Relaxations* of Bodies; the contrary Actions thereto muſt alſo be enquired into; *viz.* the *Contractions*, *Condenſations*, and Shuttings up of Bodies. And as *Contraction* is correlative to *Dilatation*; that muſt be thoroughly examined.

ARTICLE XIV.

Contractions by the ſhrinking of the groſſer Parts, after the diſcharge of the Spirits.

DIRECTION.

15. Here again, the Inſtances are to be carefully collected.

ARTI-

ARTICLE XV.

The Contraction of Bodies by actual, external Cold.

DIRECTION.

16. This is the reciprocal Action to that of Dilatation by external Heat; and the moſt genuine and proper kind of Contraction. Here, therefore, the Enquiry ſhould be more largely and fully proſecuted; ſo far as the degrees of Cold, upon the Earth's Surface, can be made to reach.

ARTICLE XVI.

The Contraction of Bodies by potential Cold.

DIRECTION.

17. Let this Article be proſecuted as the correlative to *Article* VII.

ARTICLE XVII.

The Contractions of Bodies by Flight, and Antiperiſtaſis.

DIRECTION.

18. This is the oppoſite to *Dilatation by Union and Embrace.* See *Article* IX.

ARTICLE XVIII.

TheC ontraction of Bodies by Aſſimilation or Converſion, into a denſer State.

DIRECTION.

19. This is the correlative to *Article* X.

ARTICLE XIX.

The Contractions of Bodies by external Violence.

DIRECTION.

20. This correſponds to *Article* XI.[c]

SECT.

[c] Fuller *Directions, Admonitions,* and *Precepts,* are occaſionally interſperſed in the Enquiry itſelf.

SECT. II.

A TABLE *expreſſing the* DENSITY *and* RARITY, *or Specifick Gravities, of different tangible Bodies, in proportion to* Gold ; *with the Explanation, and Uſes thereof.*

The Bodies in the following *Tables* were all taken of the ſame Bulk, or Dimenſions.

The TABLE, *in alphabetical Order.* [d]

Pure GOLD weigh'd an Ounce, or twenty Penny-Weight.

	Penny-Weight.	Grains.
Alabaſter	2	12
Alum	1	21
Amber	1	3
Aqua fortis	1	7
Aſhes, common	1	0 ½
Balſam, Indian	1	6
Beer, ſtrong	1	3 ½
Benjamin	1	0
Borage, its expreſs'd Juice	1	3 ½
Braſs, coarſe	8	9
—— fine	9	5
Brimſtone	2	2
Butter	1	0
Calve's Brain, raw	1	4 ¾
Camphire	1	4
Chalk	1	18 ½
China-root	1	2
Clay, common	2	8 ½
—— *Tobacco-pipe*	2	5 ½
Copper	9	8
Cryſtal	2	18
Earth, common	2	1 ½
Ebony-wood	1	3 ½
Fennel-ſeed, powder'd	1	3 ½
Fir-wood	0	15
Flint	2	22 ½
Glaſs	2	20 ½
Guaiacum-wood	1	10
Jet	1	5
Iron	8	6
Ivory	1	21 ½
Lead	12	1 ½
Loadſtone	5	12

Marble

[d] For the ſake of Convenience, and ready Uſe, this *Table* is ranged in alphabetical Order; tho there are conſiderable Ends anſwered alſo by diſpoſing it in the natural Order, ſo as to ſhew how Bodies run down, in a deſcending Scale, from the moſt ponderous Subſtance, GOLD ; to the lighteſt the Author tried, which was *Fir*. Whence, we judge, that both Forms ought to be preſerved ; at leaſt till a *complete Table* of the ſpecifick Gravities of all Bodies is procured : tho on many Occaſions, even then, it would be proper to have two ; one in the Order of Nature, and the other in that of the Alphabet, according to the preſent Example. See below, *Obſervation* 3. § 11.

	Penny-Weight.	Grains.
Marble	2	22 ¾
Marjoram, ſweet, in powder	0	23
Milk, Cow's	1	4 ½
Mint, its expreſſed Juice	1	4
Myrrh	1	0
Nitre	2	5
Oak-wood	0	19 ½
Oil of ſweet Almonds	0	23 ½
— *of Cloves, chemical*	1	3
— *of Mace, green, by Expreſſion*	0	23 ½
— *of Sulphur*	1	18
— *of Vitriol*	1	21
Onion, freſh	1	5
Ox Bone	2	5
—— *Horn*	1	6
Pear, Winter, raw	1	2
Pearl powdered	2	2
Petreol	0	23
Quick-ſilver	19	9
Roſe Flowers powdered	0	22
Roſe-water diſtilled	1	1
Sal-Gem	2	10
Salt, common, *in powder*	1	10
Sand, white	1	20
Saunders, red	1	5
Sheep's Blood	1	5
—— *Fleſh*	1	10
Silver, pure	10	21
Soot, common, *from the Chimney, in powder*	0	17
Spirit of Wine	0	22
Steel	8	10
Suet	1	0
Sugar, white, *powdered*	1	2 ½
Tin, block	7	22
Tin-glaſs	10	12
Touchſtone	3	1
Verjuice of Crabs	1	3
Vinegar	1	3 ½
—— *diſtilled*	1	1
Vitriol, white	1	22
Urine, common	1	3
Water	1	3
Wax, yellow	1	2
Wine, Claret	1	2 ¼

The ſame TABLE in the Order of Nature.

	Penny-Weight.	Grains.
Pure Gold	20	0
Quickſilver	19	9
Lead	12	1 ½
Pure Silver	10	21
Tin-glaſs	10	12
Copper	9	8
Fine Braſs	9	5
Steel	8	10
Common Braſs	8	9
Iron	8	6
Block Tin	7	22
Loadſtone	5	12
Touchſtone	3	1
Marble	2	22 ¾
Flint	2	22 ½
Glaſs	2	20 ½
Cryſtal	2	18
Alabaſter	2	12
Sal-Gem	2	10
Common Clay	2	8 ½

	Penny-Weight.	Grains.
Tobacco-pipe-Clay	2	5 ½
Nitre	2	5
Ox Bone	2	5
Powdered Pearl	2	2
Brimſtone	2	2
Common Earth	2	1 ½
White Vitriol	1	22
Ivory	1	21 ½
Alum	1	21
Oil of Vitriol	1	20
White Sand	1	21
Chalk	1	18 ½
Oil of Sulphur	1	18
Common Salt, in powder	1	10
Guaiacum wood	1	10
Sheeps Fleſh	1	10
Aqua fortis	1	7
Ox Horn	1	6
Indian *Balſam*	1	6
Calves Brain, raw	1	4 ¾
Sheeps Blood	1	5
Red Saunders	1	5
Jet	1	5
Freſh Onion	1	5
Cows Milk	1	4 ½
Camphire	1	4
Mint, its expreſſed juice	1	4
Borage, its expreſſed juice	1	3 ½
Strong Beer	1	3 ½
Ebony Wood	1	3 ½
Fennel-ſeed, powdered	1	3 ½

	Penny-Weight.	Grains.
Vinegar	1	3 ½
Verjuice of Crabs	1	3
Shining Amber	1	3
Urine	1	3
Common Water	1	3
Oil of Cloves, chemical	1	3
Claret Wine	1	2 ¾
White Sugar, powdered	1	2 ½
Yellow Wax	1	2
China-Root	1	2
Winter-Pear, raw	1	2
Vinegar, diſtilled	1	1
Roſe-water, diſtilled	1	1
Common Aſhes	1	0 ½
Myrrh	1	0
Benjamin	1	0
Butter	1	0
Suet	1	0
Oil of ſweet Almonds	0	23 ½
Oil of Mace, green, by expreſſion	0	23 ½
Marjoram, ſweet, in powder	0	23
Petreol	0	23
Roſe Flowers, powdered	0	22
Spirit of Wine	0	22
Oak Wood	0	19 ½
Soot, common, from the chimney, in powder	0	17
Fir-wood	0	15

The

The Conſtruction, Nature, *and* Uſe *of the* preceding TABLE.

1. THE Weights made uſe of are the common ones of the *Gold-Smith*; the Pound conſiſting of twelve Ounces; the Ounce of twenty-penny Weight; and the Penny-weight of twenty-four Grains. We make choice of *pure Gold* for the *Standard*, and adjuſt the Dimenſions of the other Bodies thereto; becauſe this is not only the heavieſt Subſtance we know; but alſo the moſt uniform, homogeneous, and without any volatile Part. The Experiments, upon which the *Table* was formed, proceeded thus. *The Weight employed.*

2. We faſhioned an Ounce of pure Gold into a ſolid Cube, and provided a ſquare Caſe, or Box of Silver, which contained and fitted it exactly; excepting only, that the Caſe roſe ſomewhat higher: but a Line was drawn on the inſide of it, at the preciſe height whereto the Gold Cube reached. This we did for the convenience of filling the Caſe with Fluids, and Powders; ſo that when either of them were put in, they might not run over, or be ſpilt; but contain themſelves level within. We likewiſe provided another ſimilar Caſe, perfectly of the ſame Weight and Dimenſions; in order to ſhew the Proportion which the Body, contained in one, bore to that contained in the other. Then cutting Cubes of the ſame Dimenſions, or Bulk, with that of the Gold, in all the ſolid Bodies ſpecified in the *Table* which would bear cutting, we fitted them exactly into the Caſes, up to the Line; and poured in our Liquors to the ſame height occaſionally. The like we alſo did by the Powders; conſtantly obſerving to ſqueeze and preſs them in ſo ſtrong, that they might lie even and uniform, without ſubjecting our Experiments to caſualty. *The Table how made.* *The* Apparatus.

3. Then for the Trials themſelves; we put one of the Caſes, empty, in one Scale, and the other Caſe, containing the Body to be examined, into the other Scale of the Balance; and ſeparately took the exact Weight of each Body ſo contained. For, as much as the Weight of the Body fell ſhort of that of the Gold; ſo much the Bulk of the Body exceeded that of the Gold. Thus, for Example, as the Gold Cube weighed an Ounce, and an equal Cube of Myrrh, weigh'd but one Penny-weight; it follows, that the Bulk of Myrrh is to the Bulk of Gold, as twenty to one: ſo that there is twenty times as much Matter contained in Gold as in an equal Bulk, or Dimenſion, of Myrrh; or again, twenty times as much Bulk, or Diſtention, in Myrrh, as in an equal Weight of Gold. *The Experiments, how performed.*

ADMONITIONS.

4. (1.) The Veſſel here employed, would not, on account of its ſmallneſs and Figure, allow the Experiments to be made with any great Exactneſs: by its means we could not eaſily take the ſpecific Gravities below a quarter of a Grain; and the little ſquare Surface of the Matter might, *Imperfection of the preſent Method, and a better directed.*

by a ſmall and inſenſible riſing, make ſome difference: ſo that Veſſels riſing ſharp and conical, are beſt ſuited for forming an *accurate Table* of this kind [e].

Experiments of ſpecific Gravities vary.

5. (2.) No doubt but many of the Bodies expreſſed in the foregoing *Table*, have a greater or leſs ſpecific Gravity than others of the ſame kind; ſo that one Wine ſhall contain more Matter in the ſame ſpace, than another; and one Wood more than another Wood of the ſame Species, *&c.* And therefore the Buſineſs of exact Trials, and ſettling the accurate Proportions of the ſpecific Gravities of Bodies, is here ſomewhat uncertain, or caſual. Nor can it be expected that the individual Bodies we made our Experiments with, ſhould be a Standard of the Nature and Gravity of each Species; or that they ſhould perfectly agree with the Experiments made by others, in the ſame manner [f].

Not made in three kinds of Bodies.

6. (3.) We have received into our *Table*, only ſuch Bodies as would commodiouſly occupy and fill up Space; whilſt the Body remained, as it were, entire, uniform, and ſimilar: and ſuch alſo as have a ſenſible Gravity in the Air; from which Gravity we might judge of their quantity of Matter. So that there are three kinds of Bodies whereto our Experiments were not applied; *viz.* (1.) thoſe that are uncapable of a cubical Dimenſion; as Leaves, Flowers, Pellicules, Membranes, *&c.* (2.) Such as are unequally porous and cavernous; as Sponge, Cork, Wooll, *&c.* And, (3.) untangible Bodies, whoſe Weight is not perceived in the Air; as Flame, Air itſelf, *&c.* [g]

Whether Bodies may acquire Weight by Condenſation.

7. (4.) Enquiry ſhould be made, whether, poſſibly, the cloſe Contraction, or Condenſation, of a Body, by an uniform Force on all ſides, will give it a greater Proportion of Gravity, than correſponds to its Quantity of Matter. This Enquiry belongs to *the particular Hiſtory of Gravity* [h]: and, if it terminate in the Affirmative, our Calculation muſt needs be erroneous; and the more rarified any Body is, it will contain ſomewhat more Matter under the ſame Bulk, than is aſſigned it by our Method [i].

The Table to be improved.

8. This *Table* I made many Years ſince; tho, ſo far as I remember, with tolerable Care and Exactneſs: but, doubtleſs, an infinitely more accurate

[e] As in *M. Homberg*'s Glaſs, for taking the ſpecific Gravities of Liquors; where a ſingle Drop is made to poſſeſs a conſiderably long Space in the ſlender graduated Neck.

[f] To this may be added the different Seaſons of the Year, and Times of the Day; as to Heat and Cold, Dryneſs and Moiſture, *&c.* All which occaſion Variations in very curious Experiments of this kind.

[g] Theſe Experiments require the Aſſiſtance of the *Air-Pump*.

[h] This Hiſtory the Author intended to write; but it was not publiſhed.

[i] This Point may now ſeem ſettled, by the Induſtry of the Moderns; ſince it is ſhewn, by Experiment, that Quantity of Matter and abſolute Gravity are reciprocal; or that the Matter in Bodies correſponds exactly to their Weight. The Queſtion here turns upon the Diſtinction betwixt *abſolute* and *relative*, or *ſpecific Gravity*. *Abſolute Gravity* is the Weight of Bodies in a perfect Vacuum, or unreſiſting Medium: and *relative Gravity*, their Weight in a reſiſting Medium; which leſſens the abſolute Gravity of a Body, in proportion to the Denſity of the Medium. So that the ſame Body weighs leſs in Air than *in Vacuo*; leſs in Water than in Air, *&c.* Therefore, in the preſent Caſe, where the Experiments are made in the Air; the Condenſation of a Body, by leſſening its Surface, will cauſe it to be leſs reſiſted by the Air; and conſequently to weigh the more. But in an abſolute Vacuum, the ſame Body ever ſo much condenſed, weighs no more than the ſame Body ever ſo much expanded.

accurate one may be formed, from trying a greater number of Bodies, and in larger Quantities; which greatly contributes to render the Experiments more juſt. And this being a fundamental thing in Philoſophy, it ſhould by all means be procured [k].

Larger OBSERVATIONS.

9. (1.) 'Tis an agreeable Proſpect to ſee, from ſuch a *Table* as this, how finite and comprehenſible the Nature of tangible Bodies is; for ſuch a *Table* graſps, as it were, all natural Bodies in the Hand. And let no Man here indulge his Fancy, or his Levity; but conſult Experience: for our *Table* ſhews, that there is no tangible Body in Nature exceeding another in Quantity of Matter, above thirty-two to one; which is the Proportion wherein *Gold* exceeds *Fir-Wood*. As for Bodies near the centre of the Earth, we can ſay nothing to them; ſince they neither come under our Senſes nor Experience: poſſibly, as they lie very remote from the heat of the celeſtial Bodies, and are quite cut off from any Communication therewith; they may be more denſe than any of the Bodies we know. *The Limits of Denſity in Bodies.*

10. (2.) There can be little Juſtneſs in that Opinion, which ſuppoſes ſublunary Bodies compoſed of the four Elements. For our cubical Lump of Gold, in the *Table*, was twenty Penny-Weight; whereas common *Earth* is little more than two; *Water* but one, *and three Grains*; and *Air* and *Fire* are ſtill vaſtly more rarified, as being not tangible, and inſenſible upon the Balance: And *Form* does not increaſe the Matter of Bodies. It muſt therefore, on this Footing, be conſidered, which way a Body of twenty Penny-Weight, can by *Form* be produced, under equal Dimenſions, from a Body of two Penny-Weight; and from others vaſtly more rarified. There are here two Subterfuges; the one, that the more rarified Elements ſqueeze the denſer to a greater cloſeneſs than the ſimple Element itſelf: the other, that the *Peripateticks* do not underſtand this of common, but of *elementary Earth*; which is heavier than any compound Subſtance. But *Fire* and *Air* do not condenſe Bodies, except by accident; as we ſhall ſhew hereafter [l]. And for the *Earth*, which ſhould be heavier than Gold, and all other Bodies; it is ſo buried, as hardly to be found, and employ'd in Mixture [m]. It were, therefore, much better for the *Peripateticks* to leave off trifling, and dictating in Philoſophy. *Bodies not compoſed of the four Elements.*

11. (3.) The *Scale of Denſity* in Bodies, or the Degrees wherein they fall from a cloſer Texture of Matter, to a looſer, ſhould be carefully noted; and how this ſometimes happens by ſmaller Steps, and ſometimes by larger Strides: ſuch a View being of ſervice, not only to inform the Judgment, but *The Scale of Denſity in Bodies.*

[k] There are ſeveral Tables of this kind extant; tho none perhaps ſo copious and exact as is on many Occaſions required. See Mr. *Boyle's* Piece of *Hydroſtatics applied to Ores, and the Materia Medica*. And for the Uſes of ſuch a *Table*, ſee hereafter, § 14, *&c.*

[l] See *Sect.* VI. and VII.

[m] See Mr. *Boyle's Sceptical Chemiſt.*

but also in leading to Practice. The Denſity of metalline Bodies is the greateſt; and runs eleven Steps downwards, from *Gold* to *Tin*; proceeding by a large ſtart from *Gold* and *Quickſilver*, to *Lead*; but gradually, or ſlowly, from *Lead* to *Tin*. Again; there is a great Leap from Metals to Stones; only the Loadſtone comes in between; which is thence proved to be of a metallic Nature [n]. But from Stones to all other Bodies, there is a continued, regular, and ſlow Deſcent.

PRECEPTS.

Whence denſe Bodies near the Earth's Surface.

12. (1.) As the Seat of Denſity may ſeem to be in the Depth of the Earth; ſo the Bodies towards its Surface ſhould be conſiderably rarified: but 'tis very remarkable, that Gold, the heavieſt of Metals, ſhould ſometimes be found, nearly in a pure State, among the Sand and Gravel of Rivers. A careful Enquiry ſhould be therefore made into the Situation of ſuch Places; to diſcover whether they lie not near the Foot, or below the Bottom of certain Mountains, or deep Mines, from whence the Gold may be waſhed: or, otherwiſe, what it is that procures ſo great a degree of Denſity, near the Surface of the Earth [o].

Mines to be enquired into.

13. (2.) It ſhould alſo be enquired, as to Mines in general, what kind of them lie the deepeſt, and what neareſt the Surface of the Earth; in what Situation of a Country, and in what kind of Glebe or Soil; how they lie with reſpect to the Waters; but particularly, in what Beds; and how they are ſurrounded, or mixed in with Stone, or other foſſil Matters. In ſhort, all the Circumſtances belonging to them ſhould be examined; in order to find out by what means the Juices and Spirits of the Earth are compacted, and condenſed into a metalline Nature, ſo much heavier than that of other Bodies [p].

Larger OBSERVATIONS.

The lighteſt Bodies to be enquired after.

14. (1.) No doubt but there are many Bodies to be found, both in Vegetables and the Parts of Animals, much lighter than *Fir-Wood*; for, we conceive that the Downs of ſome Plants, the Wings of Flies, the Skins of Snakes, and various Matters treated or produced by Art; ſuch as Tinder, dry Roſe-Leaves remaining after Diſtillation, *&c.* are not ſo heavy as the lighteſt Woods [q].

The vulgar Notion of Denſity to be rectified.

15. (2.) That erroneous Notion, to which the human Underſtanding readily inclines, in ſuppoſing hard Bodies the denſeſt, ſhould be corrected and

[n] Such Particulars as theſe are frequently taken for late Diſcoveries.

[o] The former is generally allowed to be the Caſe; *viz.* that Gold is waſhed down into Rivers, from Mines that lie higher; yet the Queſtion ſtill remains, Whence has Gold its Denſity; being often found in Mines not far below the Earth's Surface?

[p] See the Heads of this Enquiry in the *Philoſophical Tranſactions*; or in Mr. *Boyle*'s Works, Abridgment, *Vol.* III. *pag.* 8.

[q] See Dr. *Hook*'s *Micrographia* paſſim.

and reſtrain'd: for Quickſilver runs, and Gold and Lead are ſoft; yet theſe are denſer and heavier than the hardeſt Metals, Iron and Copper; and much denſer than Stones.

16. (3.) Our *Table of ſpecific Gravities*, ſhews many things contrary to Expectation; as that Metals are much heavier than Stones; Glaſs, a factitious Body, heavier than Cryſtal; that common Earth is conſiderably light; that the Oils, or diſtilled Liquors of Vitriol and Sulphur, are almoſt as heavy as crude Vitriol or Sulphur; that the Difference between the Gravity of Water and Wine is not great; that ſome chemical Oils, which ſhould ſeem lighter, are yet heavier than Oils by Expreſſion; that Bone is much heavier than Horn or Teeth: with ſeveral Particulars to the ſame effect. *The Table ſhews Particulars unexpected.*

PRECEPT.

17. The Nature of *Denſity* and *Rarity*, tho it runs thro' nearly all other Natures, without being ſubject to their Laws; yet ſeems to have a great conſent with *Gravity* and *Levity* [r]. We alſo ſuſpect it may have an Agreement with the ſlow and quick Admiſſion, and Rejection, of Heat and Cold. We would, therefore, have trial made, whether rare Bodies do not grow hot and cold, quicker than denſe ones. The Experiment ſhould be performed on Gold, Lead, Stone, Wood, *&c.* with the ſame degree of Heat, the ſame Quantity, and the ſame Figure of the Body [s]. *Denſity related to Gravity.*

Practical HINTS.

18. All the Mixtures of Bodies may be diſcovered by means of an exact *Table of ſpecific Gravities*, and the Teſt of Weight. Thus to find what Proportion of Water is mixed with Wine; Lead, with Gold, *&c.* the Mixture being weighed, and the *Table* conſulted, for the reſpective Weights of the Simples; the mean Proportion of the Compound, compared with the Simples, will give the Quantity of the Mixture. And this we judge was the Method uſed by *Archimedes*, in detecting the Debaſement of King *Hiero*'s Crown. *The Foundation of the* hydroſtatical Balance.

19. The making of *artificial Gold*, or the *Tranſmutation of Metals into Gold*, ſhould be held ſuſpect; for Gold is the heavieſt and denſeſt of all Bodies; and therefore to convert any thing elſe into it, is abſolutely the Work of Condenſation: but Condenſation can ſcarce be ſuper-induced by Men upon the Surface of the Earth; eſpecially in Bodies that are full of Matter, as Metals are. For moſt Condenſations, effected by Fire, are falſe, or imperfect Condenſations, with regard to the whole; and only condenſe Bodies in certain Parts, as we ſhall ſee hereafter [t]. *The Making of Gold deſperate.*

20.

[r] 'Tis now generally eſteemed reciprocal thereto. See above, § 7. and below, § 37.

[s] There are ſome Experiments to this purpoſe in *Boerhaave*'s Chemiſtry; particularly in the Chapter of *Fire*.

[t] Sect. VI. and VII.

The Converſion of Lead or Quickſilver into Silver not deſperate.

20. (3.) But the *Converſion of Quickſilver, or Lead, into Silver*, which is a rarer body than either, may rationally be hoped for: as requiring only Fixation, not Condenſation.

Partial Converſions of uſe.

21. (4.) Yet if Quickſilver, Lead, or any other Metal, could be turned into Gold, in all other properties except Gravity; or be rendered more fix'd, more malleable, ſoft, ductile, durable, bright, yellow; or leſs ſubject to tarniſh; it might doubtleſs prove an uſeful and gainful Operation.

A larger OBSERVATION.

22. We know of nothing heavier than Gold; nor has any Method yet been found of increaſing the Gravity of pure Gold, by Art[t].

HISTORY.

Lead increaſed.

23. But Lead has been obſerved to increaſe, both in Bulk and Weight; eſpecially by lying in Cellars under Ground, where Bodies readily grow mouldy. This has principally been obſerved in Stone Statues; the feet whereof were faſten'd together with Bands of Lead, that have been found ſwell'd; ſo that ſome Parts thereof hung prominent, or pendulous, like Warts, upon the Stone. But whether this were really an increaſe of the Lead, or only a ſprouting of its Vitriol, ſhou'd be farther examin'd[v].

24. *A* TABLE, *ſhewing the different* EXPANSION *of* BODIES, *whole and in Powder.*

	Penny-Weight.	Grains.		Penny-Weight.	Grains.
THE Cubic Veſſel of *Crude-Mercury*	19	9	THE Cubic Veſſel of the cloſe Powder of *Mercury Sublimate*	3	22
Lead	12	1½	*Ceruſe*	3	8½
Steel	8	10	Crocus Martis	2	9
Cryſtal	2	18	*Cryſtal*, ground	2	20
Red Saunders	1	5	*Red Saunders*, ground	0	16½
Oak-wood	0	19½	*Oak-Aſhes*	1	2

25. *A*

[t] The Gravity of Silver is ſaid to have been conſiderably increaſed.
[v] See Mr. *Boyle's* Works. Abridgm. Vol. III. p. 95.

25. *A* TABLE *to ſhew the different* EXPANSIONS *of* BODIES, *crude and diſtill'd.*

	Penny-Weight.	Grains.		Penny-Weight.	Grains.
Crude Sulphur	2	2	*Oil of Sulphur*	1	18
Vitriol	1	22	*Oil of Vitriol*	1	21
Wine	1	$2\frac{3}{4}$	*Spirit of Wine*	0	22
Vinegar	1	$3\frac{1}{2}$	*Diſtill'd Vinegar*	1	1

ADMONITION.

26. The manner of reducing a Body to Powder, contributes greatly to the opening, rarifying, or expanding of that Body. But the reduction of a body to Powder by ſimple triture, or by filing, is one thing; by chemical Sublimation another; by Corroſion with acid Spirits, another; and by Calcination, another; ſo as to have very different Effects. *The different kinds of Pulverization, rarify differently.*

PRECEPT.

27. Theſe two *Tables* are extremely ſcanty and defective; but that wou'd be an exact and copious one of Bodies and their Expanſions, which in the firſt Column contain'd the weight of each Body; in the ſecond the weight of its crude Powder; in the third, that of its Aſhes, Calx, or Ruſt; in the fourth, that of its pappy Maſs; in the fifth, that of its Vitrification, if it be vitrifiable; in the ſixth, its Matter by Diſtillation; in the ſeventh that of its Solution, ſubducting the weight of Liquor that diſſolves it; and ſo on, till it exhibits the weights of the ſame Body under all its Changes, and other Alterations: from which *Table* a judgment might be form'd of the relaxations of Bodies, and the cloſeſt integral Connexions of Nature. *The preceding Tables to be improved.*

OBSERVATION.

28. Pulverization is not properly a rarifaction of the Body pulverized; becauſe the increaſe of Bulk proceeds not from the dilatation of the Body; but from the interpoſition of Air: yet an eſtimate of the internal Connexion, or poroſity of Bodies may be excellently derived from it. For the cloſer Bodies unite, the greater difference there is between their Powder and entire Body; and therefore Quickſilver is to Mercury-Sublimate in Powder, as above five to one; and the proportions of Steel and Lead to prepared Steel, and Ceruſe in Powder, are not ſo much as four to one. But in the lighter and more porous Bodies, there is ſometimes a looſer poſition of Parts, in the wholes, than in the preſs'd Powders; ſo the Aſhes of Oak-wood are heavier than Oak itſelf. And again, in Powders, the heavier the entire Body is, the *Pulverization not properly a Rarifaction.*

leſs Dimenſion its ſqueez'd Powder has, in Compariſon of another unſqueezed: for in light Bodies the Parts of Powders may ſuſtain or ſupport themſelves; ſo that an unſqueezed Powder ſhall poſſeſs thrice the ſpace of a ſqueezed one; on account of its leſs condenſing, and dividing the Air interpoſed betwixt its Parts.

Wine made much lighter than Vinegar by Diſtillation.

29. (2.) Diſtill'd Bodies are generally rarified, and made light, by the Operation; but Wine twice more than Vinegar.

A Speculation for Practice.

Tangible Bodies reducible to Claſſes, according to their ſpecifick Gravities.

30. And thus tangible Bodies may be reduced under Claſſes, according to their Families; or as they prove rich or poor in Matter. But there is another Claſs of Things, which we call pneumatical, or untangible; ſo that not being ſubject to the Balance, no judgment can be form'd of the Diſtention, or Rarifaction, of the Matter they contain. Whence this Affair requires another kind of *Interpretation*. But firſt; the ſeveral Species of pneumatical Bodies are to be laid down; that they may be compared with each other. But as in the Caſe of tangible Bodies, we for a time poſtpone the Conſideration of the internal Parts of the Earth; ſo in the Caſe of pneumatical Bodies, we poſtpone for a time, thoſe that are ethereal.

Pneumatical Bodies claſſed. The imperfect.

31. We range *pneumatical Bodies* under three general Claſſes; *viz.* (1.) The *imperfect*; (2.) the *confined*; and (3.) the *pure*. (1.) The imperfect are, *Fumes* of all kinds, proceeding from different matters. Theſe may ſtand in this order; 1. *Volatile Fumes* that breathe out from Metals and ſome other Foſſils; being, as their Name imports, rather volatile than pneumatical; and very eaſily coagulated either by Sublimation or Precipitation. 2. *Vaporous Fumes*, expiring from Water and aqueous Bodies. 3. Under the general Name of Fumes, we likewiſe include the *Expirations of dry Bodies*. 4. *Exhalations* proceeding from oily Bodies. 5. *Breaths* afforded by Bodies aqueous in their Subſtance, but inflammable in their Spirit; as in Wines, and other fermented ſpirituous Liquors.

After-Fumes.

32. There is alſo another kind of Fumes in which Flame terminates; and ſuch as expire only from inflammable Bodies, conſequent to the Flame: and theſe we call *After-fumes*, or *Secondary-fumes*. So that there can be no *After-vapours*, becauſe aqueous Bodies are uninflammable; but there may be *After-fumes*, in our particular Senſe, as alſo *After-exhalations*, *After-breaths*, and probably *After-volatile* Parts in ſome Bodies.

Confined and pure pneumatical Bodies.

33. (2.) But *confined pneumatical Bodies* are thoſe found, not independent or free, but included in tangible Bodies; and are what we commonly call *Spirits*. Theſe participate both of an aqueous and oily Subſtance; and are nouriſhed and fed thereby: and being converted into a pneumatical Subſtance, they conſtitute a Body, as it were conſiſting of Air and Flame; and thence produce the ſtrange effects of both *. Theſe Spirits, with regard

to

* See the *Axioms* at the End of the Hiſtory of Life and Death.

to pneumatical Bodies that are free and at large, nearly approach to the nature of *Breaths*; such as arise from Wine, *&c.* And these Spirits are of two kinds; the one of crude and the other of living Bodies. The *crude Spirits* are contained in all tangible Bodies; but the *living Spirit* only in such as are animated, whether of the vegetable or sensitive Kingdom. (3.) But there are no more than two *pure pneumatical Bodies*, viz. *Air* and *Flame*; tho these also are subject to great diversity, and receive very unequal degrees of Extension.

34. *A* TABLE *of pneumatical Bodies; conformable to the preceding Speculation*; as they receive, in Order, a greater degree of Extension.*

THE volatile parts of Metals and Fossils.
The After-volatile parts of the same.
Vapours.
Fumes.
After-Fumes.
Exhalations.
After-Exhalations.
Breaths.
After-Breaths.
Crude Spirits, confined in tangible Bodies.
Air.
Living Spirit, confined in tangible Bodies.
Flame.

Levity affords not a corresponding Scale to Gravity.

35. We are next to consider the respective Extensions of these pneumatical Bodies; as well with regard to themselves, as to tangible Bodies. And here it might be well, if the Nature of Levity, by an ascending Scale, wou'd elucidate and correspond to the Rarifaction of Bodies; as the Nature of Gravity, by a descending Scale, does to their Density. But several Difficulties interpose: as first, that the Differences of the Motions in Objects invisible, are not immediately perceived by the Senses. Secondly, that in Air, and the like Substances, there is not found so strong an Appetite of moving upwards, as Men imagine. And lastly, if the Air did move upwards; yet, as it is generally continued along with other Air, the Motion wou'd be difficultly perceived. For as Water does not preponderate in Water; so Air does not rise up against, and displace Air. And therefore other Methods must be invented[x].

* § 28.
[x] If this wants any illustration, see above § 8. See also hereafter § 37.

The Expansions of pneumatical Bodies hard to assign.

36. There are certain considerable Proofs of the proportionate Expansions of pneumatical Bodies, with regard to each other; shewing also at the same time, that the Series of Rarifaction expres'd in the *Table*, has a solid Foundation: but for the precise degrees of this Expansion, and the comparative Expansion of a pneumatical with a tangible Body, the Enquiry is more difficult.

Fumes *less rare than Air.*

37. All *Fumes*, whether primary or secondary, do not, 'tis highly probable, come up to the rarity of the Air; they being visible; but the Air invisible: nor do they themselves remain visible after being mixed along with the Air.

After-fumes *rarer than* Fore-fumes.

38. 'Tis manifest that *After-fumes* are more subtile, and rarified, than *Fore-fumes*; as being no other than the Calxe's and Resolutions of that subtle Body Flame itself. And so it appears from Experience, that tho numerous Lights continue for a long time burning in a Room, or large Assembly, the Air is not thereby unfitted for Respiration; notwithstanding so many *After-fumes* are received into it: but if the Lights were to be extinguished, and their *Fore-fumes*, or fuliginous Steams, to be received instead of the former; the Air wou'd soon prove suffocating to the Company.

Crude Spirits denser than Air.

39. We likewise judge that all *crude Spirits* confin'd in tangible Bodies, are denser than Air: for the Spirits of Vegetables, dead Creatures, or the like, do, upon their Exhalation, manifestly detain some gross, or tangible Parts; as appears from Odours; which being nothing but Fumes going out sparingly, and a little at a time; (as we see in such Fumes and Vapours as are visible;) yet if they meet with any suitable, or soft, tangible Body, they apply themselves to it, stick therein and communicate their Odour: whence, 'tis plain, that they obstinately retain an affinity with gross Bodies.

Living Spirits rarer than Air.

40. But we conceive *living Spirits* to be somewhat rarer than Air; because they are a little like Flame [y]; and again because, upon careful Experience, we have found that Air has no power to diminish Weight: for a blown Bladder is not lighter than an empty and compressed one; nor is a Sponge or a Fleece of Wool full of Air, lighter than the same when empty, or with the Air squeezed out. But the Bodies of Animals differ sensibly in their Gravity before and after Death; tho not so much as is commonly conceived [z]. Therefore *Air* seems not at all to diminish Gravity; as the *living Spirit* appears to do: and as Weight is the Criterion of *Density*; so the diminution of Weight shou'd be the Criterion of *Rarity* [a].

41. *Flame*

[y] See the *Axioms* at the End of the History of Life and Death.

[z] It shou'd seem as if the Author had made some Experiments about the weight of animal Bodies alive and dead; and that these Experiments did not agree with those of Mr *Boyle*; who upon weighing a live Mouse and a Kitten, then strangling them, and immediately weighing them again, found them a little lighter. See *Abridgm.* Vol. II. p. 527. This matter requires to be farther prosecuted; and at the same time it shou'd be fully tried, whether Eggs gain in weight upon their Animation.

[a] See § 15. Let the distinction of *specifick* and *absolute* Gravity, be well remember'd; and that in common weighing, the Experiment is made in a gravitating Fluid. Thus if the Body collapse, or shrink, after Death, it might when weigh'd in Air, prove heavier upon the Balance, than when alive. This Affair seems subject to many Contingencies: and it requires great Caution to make a valid Experiment therein.

41. *Flame* comes laſt in this Series; becauſe Flame manifeſtly aſcends: and again, becauſe the Natures of pneumatical Bodies differ not from thoſe of the tangible Bodies that ſupply them. And, therefore, as Oil is rarer than Water; ſo Flame ſhou'd be rarer than Air, and Spirit. Again, Flame ſeems to be a thinner, ſofter, and more yielding Body than Air; ſince the lighteſt Commotion of the Air near a burning Taper, will cauſe the Flame to tremble. *Flame rarer than Air.*

HISTORY.

42. How great ſoever the difficulty might be of diſcovering the Expanſion of a pneumatical, with regard to a tangible Body; yet we have not deſpaired thereof: and it ſeems to us a very certain kind of Proof, if any tangible Body of a known Expanſion, cou'd be converted into a pneumatical Body; and then the Expanſion of that be likewiſe obſerved; ſo as, from a Compariſon of the two Proportions, an evident Demonſtration might be had of the Dimenſions upon the Rarifaction. *How to diſcover the Expanſion of a pneumatical, with reſpect to a tangible Body.*

43. We, therefore, took a ſmall glaſs Vial, capable of containing about an Ounce; and poured into it half an Ounce of Spirit of Wine; which being the lighteſt of Liquors, comes neareſt to a pneumatical Nature: then taking a new and large Bladder, capable of containing a Gallon, and ſqueezing all the Air out of it, as exactly as poſſible, till the ſides came cloſe together; and alſo rubbing its outſide well with Oil, to make it ſtill more cloſe and pliable; we tied its Neck tight, over the mouth of the Vial, with a wax Thread. We now placed the Vial over warm Embers in a Chaffing-diſh; when preſently the Vapour of the Spirit of Wine aſcended into the Bladder: and ſtrongly inflated it every way. Then immediately removing the Glaſs from the Fire, and pricking a Hole in the top of the Bladder, that the Vapour might rather get out, than fall back into Drops; we took the Bladder away from the Vial, and examin'd by the Balance what proportion of the half Ounce of Spirit was wanting, or turned into Vapour; and found it to be not more than ſix penny-weight: ſo that ſix penny-weight of Spirit of Wine, which in that ſtate did not poſſeſs above one fortieth part of a Pint, being turned into Vapour occupied the ſpace of eight Pints. *An Experiment for the purpoſe.*

ADMONITION.

44. The Bladder began to grow ſomewhat flaccid upon being removed from the Fire; ſo that notwithſtanding ſuch a conſiderable Expanſion, the Vapour did not ſeem converted into a pure and fix'd pneumatical Body; but inclined to recover itſelf. And this Experiment may prove fallacious, if it be hence conjectured that common Air is ſtill rarer than this kind of Vapour; becauſe we conceive that Spirit of Wine turn'd pneumatical, tho but imperfectly, does, by reaſon of the Heat, exceed the rarity of cold Air; as Air itſelf is by Heat dilated very conſiderably, and greatly exceeds the *The Experiment how to be underſtood.*

Expanſion of cold Air. Whence we judge that if the Experiment were made with Water, the degree of Expanſion wou'd be much leſs; tho the Body of the Water contained more Matter than Spirit of Wine.

HISTORY.

Expanſion of Flame greater than Fume.

45. If the Fume proceeding from a Wax-taper, newly put out, be view'd, and an Eſtimate be form'd of its Dimenſions by the Eye; and again, if the Body of the Fume be afterwards ſet on Fire, the Expanſion of the Flame will appear to exceed that of the Fume, as about two to one.

ADMONITION.

An apparent contradictory Phænomenon reconciled.

46. A few Corns of Gunpowder being ſet on Fire, there appears to be a great Expanſion made, with reſpect to the Body of the Powder; tho when the Flame is extinguiſh'd, the Body of the Fume expands itſelf much more. But let it not hence be ſuppoſed, as if the tangible Body were more expanded in Fume than in Flame; the reaſon of the Phænomenon being this; that Flame is an entire Body, but Fume a Body mix'd with a much larger Portion of Air: and therefore; as a little Saffron tinges a large quantity of Water; ſo a little Fume diffuſes itſelf in a large proportion of Air. For a thick, denſe Fume, not diffuſed, appears leſs than the Body of Flame; as we before obſerved.

HISTORY.

Oil turn'd into Flame.

47. A piece of freſh Orange-peel being ſuddenly ſqueezed betwixt the Fingers, and directed to the Flame of a Candle; there ſtarts out a dewy oily, aromatick Matter, in fine Drops; that makes a very large Body of Flame, in reſpect of thoſe little Drops.

A larger OBSERVATION.

The Ariſtotelian Notion of the rarity of the Elements fictitious.

48. That *Peripatetical* Fiction, as to the rarity of the Elements being in a tenfold Proportion to one another, is arbitrary and hypothetical: for 'tis certain that Air is, at leaſt, a hundred times rarer than Water; and Flame a hundred times rarer than Oil; and that Flame is, at leaſt, ten-times rarer than Air.

ADMONITION.

The preceding Enquiry not to be miſconſtrued.

49. This Enquiry and Speculation, about pneumatical Bodies, ſhou'd not be thought too ſubtile or too curious; becauſe 'tis certain that an omiſſion, and want of attending to it, has ſtupefied both *Philoſophy* and *Medicine*; and rendered them, as it were, Planet-ſtruck in the true inveſtigation of *Cauſes*: whilſt they have unprofitably attributed thoſe Things to *Qualities*, which are owing

owing to *Spirits* [b]. And ſo much for the Enquiry into the Expanſion of Matter in Bodies, according to their different Conſiſtencies, whilſt at reſt.

SECT. II.

Of DILATATIONS *cauſed by ſimple* INTROSUSCEPTION, *or the admiſſion of one Body into the Pores of another.*

ADMONITION.

A ſtrict method here purpoſely neglected.

1. IT wou'd not have been difficult for us, to have reduced the following *ſcattered Hiſtory*, to a better Order, and Method; and to have ranged ſimilar *Inſtances* by themſelves: but we avoided this exactneſs for two Reaſons; *Firſt*, becauſe many of the Inſtances are of a doubtful Nature, and bear relation to ſeveral Things: whence an exact Method, in this Caſe, wou'd either cauſe Repetition, or be apt to deceive. *Secondly*, The principal Reaſon of our rejecting an exact Method at preſent, is becauſe *we would have the Work lye open to every Man's Induſtry and Imitation.* But if this Collection of Inſtances, ſhou'd have been diſpoſed in any artificial, and extraordinary Method; many, doubtleſs, wou'd have deſpaired of performing any thing equal to this Enquiry. We, therefore, direct, both by our own Example and Admonition, that every one in procuring and propoſing *Inſtances*, wou'd uſe his own Judgment, Memory and Convenience. 'Tis ſufficient to have the Enquiry proceed by Writing, and not by Memory, (which indeed wou'd be ridiculous, in ſuch a multitude of Inſtances,) ſo that it may be afterwards brought to perfection by the *Light of Induction* [c]. And it muſt be well remembered, that in this Work, *we only collect* ALMS *and* TRIBUTE *from the Senſes, for the Treaſury of the Sciences*; without propoſing Examples for the illuſtration of *Axioms*; but endeavouring after Experiments for the formation of *Axioms*. We ſhall not, however, be wholly regardleſs of all Arrangement in our *Inſtances*, but place them ſo as they may afford Light to each other.

Unconnected HISTORY.

Dilatation upon Introſuſception, no proper Rariſaction.

2. No wonder if the Dilatation of a Body enſues upon the Introſuſception of another Body; ſince this is plainly an Augmentation or Addition; tho

[b] See the *Axioms* in the History of Life and Death. *Pag.* 418 &c.

[c] The *Directions* and *Examples* deliver'd in the ſecond Part of the *Novum Organum*, ſhou'd be well remember'd thro the Courſe of the Author's *particular Enquiries*, as being what himſelf had a conſtant regard to. And we are perſuaded, that one half of the Uſe and Excellence of his *Enquiries*, is not perceived by the generality of Readers, for want of attending to this Intimation.

tho not a genuine Rarifaction. But where the Body, thus received within the Pores of another, is of the pneumatical kind; as Air or Spirit; or if it be a tangible Body, that ſlides gradually in, and ſlowly inſinuates itſelf; this is commonly accounted rather a Tumefaction than an Addition.

Inſtanced in tenſile Bodies.

3. Tenſile or extendible Bodies, as Bladders, Bellows, *&c.* are inflated and diſtended by the entire Body of the Air; ſo as to become hard, and capable of being ſtruck, toſs'd, and projected. And a bubble of Water is like a Bladder; but for its fragility and tenderneſs.

Liquors mix'd with Air.

4. Liquors poured from on high, out of one Veſſel into another, or ſtrongly agitated with a Spoon, the Wind, the Breath, *&c.* are mix'd in along with the Air; and thus raiſed into Froth: but ſoon afterwards, they ſubſide and ſhrink into leſs ſpace; the Air eſcaping again, as the little bubbles of the froth break away.

Bubbles.

5. Children, for Diverſion, make Caſtles of Bubbles, by blowing with a Pipe into ſoapy Water; which thus becoming ſomewhat tenacious, a very ſmall quantity of Water is made to poſſeſs a large ſpace, by the Air received within it.

No frothy mixtures of Flame and Air.

6. But 'tis not found that Flame can thus be mix'd, and made frothy with Air, by the inflation of Bellows, or other external agitation; ſo as to conſtitute a mix'd Body of Flame and Air, like to Froth; which is a mixture of Air and Liquor.

Yet Flame and Air are mix'd in Gunpowder.

7. On the contrary, 'tis certain that by internal mixture in a Body, before it is ſet on Fire, a mix'd Body may be made of Air and Flame: for *Gunpowder* has uninflammable Parts from the *Nitre*, and, its inflammable Parts principally from the *Sulphur*; whence the Flame of Gunpowder becomes whiter or paler than other Flames[d]; tho that of Sulphur alone be bluiſh; inſomuch that the Flame of Gunpowder may be juſtly compared to a moſt expanſive Froth, or a kind of a fiery Wind, compoſed of Flame and Air[e].

Powders compoſed of Air, and the pulverized Body.

8. But as Froth is a Body compounded of Air and Liquor; ſo are all Powders compoſed of Air and the ſmall Parts of the pulverized Body: whence they differ from Froths, only as contiguous differ from continuous Bodies. For the great bulk of them is cauſed by the Air; which diſtends, or ſets the Parts of the Body at a diſtance; as appears from the *ſecond* and *third Table* above laid down[f].

Tumefactions in Animals.

9. There are Tumefactions in the Bellies, and other Parts of Animals, ariſing from Flatulency, and an aqueous Humour collected within; as in the Caſe of the Tympany, Dropſy, and the like.

Powting Pigeons.

10. There is a kind of Pigeon, which ſhrinking its Head within its Neck, pouts and ſwells, conſiderably.

11. In

[d] Except that of Camphire, and certain artificial mixtures, as in the Compoſitions of the Stars for Sky-Rockets, *&c.*

[e] The more intimately the Thing is conſider'd, or rather, the more Experiments are made to give a proper Information therein; as by the Analyſis of Nitre, Gunpowder, *&c.* the more juſt the Compariſon may, perhaps, appear.

[f] Sect. I. §. 22, 23.

10. In the Action of Reſpiration, the Lungs alternately expand and contract, while they receive and diſcharge the Air, like a Pair of Bellows. *Reſpiration.*

11. The Breaſts of pregnant Females ſwell, and grow turgid, from the milky Humour contained within them. *Swelling of the Breaſts.*

12. The *Penis* of the Male is greatly dilated, in Bulk, upon Erection. *The* Penis.

13. Obſerve the Breadth of the *Pupilla* of either Eye in a Looking-glaſs, then cloſe the other Eye; and you will perceive the *Pupilla* of the open Eye manifeſtly dilated: the Spirits that ſerved for both Eyes, now flowing into one. *The Eyes.*

14. The Cracks and Fiſſures of Bowls, and the like Materials of Wood, being contracted by Dryneſs, are filled up and conſolidated, by lying for awhile in Water; and receiving it within their Pores. *Dry Wood-work, in Water.*

15. There is a kind of *Fungus* growing upon a Tree, and called by the Name of *Jews-Ears*, that being put into Water ſwells exceedingly [g]; which Wooll and Sponge do not [h]. And ſo much for the *Introſuſception* of a different Body; which is, in reality, but a falſe kind of *Rarifaction.* *Jews-Ears.*

SECT. III.

Of the DILATATIONS *proceeding from the* INNATE SPIRIT, *expanding itſelf.*

TRANSITION.

1. WE paſs on to the Dilatations and Tumefactions made in Bodies, by their *innate Spirit*; whether theſe Tumefactions and Dilatations be *natural*, or *præternatural*, as they are called; yet, without Fire, or manifeſt external Heat: tho in theſe Caſes alſo there may ſometimes follow an Addition, or Introſuſception of Moiſture, beſides the ſimple *Dilatation* itſelf. *Dilatation and Tumefaction, natural and præternatural.*

2. Muſt, new Wines, or other fermenting Liquors, when put up into the Caſk, ſwell and riſe conſiderably, ſo as to burſt the Veſſel, unleſs they get Vent: and when Vent is given, they heave and froth over, as if it were by Ebullition. *Inſtances in fermenting Liquors.*

3. Spirituous Liquors being cloſe confined, or hard ſtopt down in Bottles, often burſt them with a great Force; and ſometimes throw out the Cork, or Stopple, almoſt like a Bullet out of a Gun. *Vinous Liquors after Fermentation.*

4. The Seeds of Plants, as of Peaſe, Beans, *&c.* are obſerved to ſwell a little, before they ſtrike Root, or ſhoot into a Stem. *Seeds.*

[g] Eſpecially if boiled in Water; where they ſwell to five or ſix times their own Dimenſions, when dry.

[h] Let the Number of theſe *Inſtances* be augmented.

Tears of Trees. 5. Trees ſwelling with their native Juice and Spirit, ſometimes burſt their Bark, and thence diſcharge Gum and Tears.

Gems. 6. Many of the Gems ſeem to be Eruptions of pure Juices, ſtrained thro' the Rocks: for both Gums and Gems appear, from their Tranſparency and Splendor, to be ſtrained and depurated Juices; ſo that even Rocks and Stones may ſwell with their native Spirit [i].

Animal Sperm. 7. And no doubt, but in the Sperm of Animals, in the firſt Act towards Vivification there is a certain Expanſion of the Maſs.

Vitriol. 8. Vitriol ſhoots out an Efflorescence, and ſprouts or grows, almoſt like a Tree [k].

Stones. 9. Stones, with Time and Age, ſhoot out a Salt, eſpecially in moiſt places, that reſembles Nitre [l].

Earth ſwelling with Nitre. 10. All Glebe-Earth ſwells with Nitre; for any kind of Ground that remains covered, and heaped up, ſo that its Juice ſhall neither be exhauſted by the Sun and Air, nor conſumed in the growing of Vegetables, will collect Nitre, as an internal Tumefaction. Hence in certain Parts of *Europe* they make artificial Mines of this Salt, by preſerving and ſtoring up Earth in Houſes prepared for the purpoſe, and excluding the Rays of the Sun [m].

Dilatation in Sweat. 11. Sweat, in Animals, proceeds from a Dilatation of the Spirits; and, as it were a Liquefaction of the Juices, by Motion.

The Pulſe. 12. The Pulſe of the Heart and Arteries, in Animals, proceeds from the never ceaſing and alternate Dilatation and Contraction of the Spirits [n].

Voluntary Motion. 13. So, likewiſe, the voluntary Motion of Animals, which in the more perfect kinds of Creatures, is performed by means of the Nerves, ſeems to have its Foundation, firſt in the Compreſſion, and then in the Relaxation of the Spirits.

Tumors. 14. A Tumor follows upon the Contuſion of any Limb, in Animals; and frequently alſo upon Pains.

Stinging, and Bite of a Viper. 15. The Stinging of Waſps and Bees, produces a large Tumefaction, in proportion to the Wound; but the Bite of a Viper does this in a ſtill greater degree.

Nettles. 16. Nettles, Bryony, and the like, raiſe the Skin, and cauſe Bliſters upon it.

Poiſon. 17. The Swelling of the Face, or Body, is accounted an evident Sign of Poiſon; eſpecially of that kind which operates by a malignant Quality, and not by Corroſion.

Bliſters. 18. In the common Bliſters made by Cantharides, there ariſes a watery Humour, or Ichor, which flows out upon pricking or cutting of the Skin.

19. All

[i] See Mr. *Boyle of the Origin and Virtues of Gems.*

[k] Particularly the artificial Vitriols of *Silver*, and *Iron*, as we ſee very remarkably in the *Arbor Dianæ*, and *Arbor Martis*, as they are called. See ſeveral curious Papers upon this Subject in the *French Memoirs.*

[l] Of this ſee *Glauber* in his *Proſperity of Germany*; and *Stubbs's* Anſwer to *Henſhaw's Hiſtory of Nitre.* Conſider alſo of the Iſicles in Wine-Vaults, *&c.*

[m] See M. *Lemery's* two Papers *of the Origin of Nitre*, in the *French Memoirs*; and compare them with the Account of *Glauber.*

[n] Let this be carefully compared with what is delivered relating to the ſame purpoſe in the Author's *Hiſtory of Life and Death.*

19. All Puſtules proceeding from an internal Cauſe, and the like Eruptions, and Impoſtumations, bring on apparent Tumors, and raiſe the Skin [o]. *Puſtules.*

20. Sudden Anger, in ſome, inflates the Cheeks; ſo likewiſe does Pride and Haughtineſs. *Anger and Pride.*

21. The Bodies of the Frog and the Toad are ſubject to Tumefaction; and many other Animals, in the way of Fierceneſs, bruſtle up their Combs, Hair, or Feathers; from a Contraction of the Skin, by means of a ſwelling of the Spirits. *Animals ſwelling.*

22. Turkey-cocks ſwell themſelves greatly, and bruſtle up their Feathers a-ſtrut. And Birds, while they ſleep, have their Bodies ſomewhat tumid; the Spirit being then dilated by the natural Heat of the internal Parts. *Birds.*

23. The native Spirits of a Body begin to ſwell, in all caſes of Rottenneſs, and Putrefaction; when theſe Spirits haſtening to come forth, diſſolve and alter the Texture of the Body: and if its Structure be ſomewhat viſcous and tenacious, ſo as to prohibit their Exit, they contribute to the Production of new Forms; and then generate Inſects, Worms, *&c.* but the Origin of this Act is, from the Dilatation of the Spirits [p]. *Putrefaction.*

24. Nor does the Spirit, confined in Putrefaction, contribute only to the Production of living Creatures; but alſo produces the Rudiments of Vegetables: as appears in Moſs; and the Roughneſs on the Coats of ſome Trees. *Vegetation.*

25. Having once, by accident, left a cut Citron in a Parlour, for two Months in the Summer; I afterwards found a ſprouted Putrefaction on the part that was cut, appearing to riſe in certain Hairs, the height of an Inch; and on the Top of each Hair grew a Head, like the Head of a ſmall Iron Nail; thus plainly beginning to reſemble a Plant [q].

26. In like manner Ruſt is produced on Metals; Scurf on Glaſs, *&c.* from the Dilatation of the native Spirit, which ſwells, and drives the groſſer Parts before it; ſo as to thruſt them out at the Surface [r]. *Ruſt.*

27. It ſhould be examined, whether the Earth ſwells on its Surface; eſpecially where the Glebe lies ſpongy and hollow. There have ſometimes been found Trees, like the Maſts of Ships, lying buried under Ground, to the depth of ſeveral Feet: whence it ſhould ſeem, that ſuch Trees were once blown down by Storms; and that the Earth gradually raiſed itſelf over them [s]. *Whether the Earth ſwells.*

[o] As in the Small-Pox, *&c.* Here alſo might be mention'd the ſwelling of the Tongue and Head upon Salivation, *&c.*

[p] This Inſtance ſhould be well conſider'd, as to its Juſtneſs; or rather, a competent Set of Experiments ſhould be made to determine the Fact: for it appears not exactly determined at preſent.

[q] This Experiment ſeems not contingent but conſtant. And the curious microſcopical Obſervers have made ſeveral Species of theſe kinds of *Superfœtations*, or Vegetations upon Vegetables. See Mr. *Boyle*, Dr. *Hook*, Dr. *Grew*, the *French Memoirs*, &c.

[r] If the *Cauſe* of Ruſt were here juſtly aſſigned; ought not the ſame Effect to happen *in Vacuo?* The Fact may deſerve to be better enquired into; the ſeveral ways of making *Crocus Martis* conſider'd; the Compoſition and Faults of Glaſs examin'd, *&c.*

[s] See the Account of the Generation of Moſſes, in the *Philoſophical Tranſactions.* See alſo Mr. *Evelyn's Sylva.*

Earthquakes. 28. The Earth ſwells, manifeſtly and ſuddenly, in Earthquakes; at which time there frequently burſt forth Springs of Water; Wreaths, and Globes of Flame; violent and ſtrange Winds; and Stones and Aſhes are toſſed into the Air.

29. But all Earthquakes are not ſudden; for ſometimes the Earth continues in a Tremor ſeveral Days: and in our time there was, in *Herefordſhire*, a very ſmall, gentle, and ſlow Earthquake; wherein ſome Acres of Land continued gradually moving for a Day together; and then transferred themſelves into another Place that lay not far off, upon a Declivity; and there reſted [t].

Tumefaction of the Sea. 30. It ſhould be examined, whether the Body of the Waters does ſometimes ſwell in the Seas; for the Flux of the Sea muſt either happen, (1.) from a progreſſive Motion; (2.) the riſing of the Waters upwards, by ſome attractive Virtue; or elſe, (3.) from ſome Tumefaction or Relaxation in the Waters themſelves. And this latter, if it be any Cauſe of the flowing of the Sea, belongs to the preſent Enquiry [v].

In Wells. 31. The Water ſwells and falls again in certain Springs and Wells; as if it were in the way of ebbing and flowing.

32. There alſo ſometimes break out, in certain Places, Springs of Water, without any preceding Earthquake; and this in certain Periods of Years, from uncertain Cauſes. Such Eruptions of Water generally happen in great Droughts.

Sea ſwelling againſt Storms. 33. It ſhould likewiſe be obſerved, that the Seas ſometimes ſwell out of the time of Flood; and without any external Wind: and that this generally precedes ſome great Tempeſt or Storm.

PRECEPT.

Whether ſmall Parcels of Water do not expand. 34. 'Tis worth trying, whether ſome Relaxation may not happen in the Body of Water, even in a ſmall Quantity. But to expoſe Water to the Sun or Air, would rather conſume it; therefore the Experiment ſhould be made in a cloſe Glaſs. For example, into a large bellied Glaſs, having a long and ſlender Neck, pour ſo much Water as may fill the Belly, and lower part of the Stem. Let this be done in a dry Seaſon, when the Wind ſtands northerly; and let the Glaſs remain thus till the Weather becomes rainy, and the Wind ſoutherly; then obſerve whether the Water riſes at all in the Neck of the Glaſs [w]. A careful Enquiry ſhould alſo be made about the ſwelling of Water in Wells; as, whether it happens more by night than by day; and at what Seaſon of the Year.

HIS-

[t] This kind of local Motion, likewiſe ſaid to happen in certain ſandy Deſarts, requires to be farther examined.

[v] See the *Novum Organum*, Part II. *Aph.* 36.

[w] See *Nov. Organ.* Part II. *Aph.* 13. (38.)

HISTORY.

35. (1.) In rainy Weather, the Pegs of Violins become ſwell'd, and hard to ſcrew; ſo likewiſe wooden Drawers are harder to draw out, and Doors with wooden Hinges, harder to open in wet Weather. *Wood-work ſwelling.*

36. (2.) The Strings of a Violin are apt to break, when tight ſtretch'd in rainy Weather. *Muſical Strings.*

37. (3.) The Humors in the Bodies of Animals, are obſerved to be relaxed, to ſwell, to run, to oppreſs, and block up the Pores moſt, in rainy Weather, and ſoutherly Winds. *Humors of Animals.*

38. (4.) 'Tis a received Opinion, that the Humors and Juices, not only in Animals, but alſo in Plants, ſwell and fill up the Cavities moſt about the Full of the Moon. *Juices of Plants.*

39. (5.) Salts diſſolve, open, and dilate themſelves in moiſt Places; ſo likewiſe, in ſome meaſure, do Sugar and Sweet-meats; which are apt to grow mouldy, unleſs they ſtand in a Room where a Fire is ſometimes kept. *Salts.*

40. (6.) All Things that have paſſed the Fire, and are conſiderably ſhrunk, grow ſomewhat relaxed with Time. *Things dried by Heat.*

41. (7.) Diligent Enquiry ſhould be made into the Tumefactions and Relaxations of the Air; and how far the Cauſes of the Wind depend upon them: ſince Vapours are neither commodiouſly collected into Rain, nor diſſipated into clear Air, without cauſing Swells in the Body of the Air [w]. *The Air.*

SECT. IV.

Of the DILATATION *and* RELAXATION *of Bodies, by the means of Fire, and actual, ſimple external* HEAT.

TRANSITION.

1. FROM the Heap of Nature, we have above taken a few Inſtances of the Dilatation of Bodies owing to their native Spirit; whether in Maturations, the firſt Rudiments of Generations, the Excitations by Motions, natural and preternatural Irritations, or in Putrefactions and Relaxations: we next come to thoſe Openings and Dilatations procured by Fire, and actual external Heat.

ADMO-

[w] See the *Hiſtory of Winds*, paſſim.

ADMONITION.

Relaxations by Fire concern this Enquiry.

2. The Relaxations of Bodies by *Heat* or *Fire*, properly belong to the *Titles* of *Heat* and *Cold*, the Motion of *Dilatation*, and those of *Separations*, and *Alterations:* but they must be touched under the present *Title*; because, without a little knowledge of them, the *Enquiry of Denſity and Rarity* cannot be well conducted.

HISTORY.

Air dilated by Heat.

3. (1.) Air is ſimply dilated by Heat: for in this Caſe there is nothing ſeparated or emitted, as in tangible Bodies; but barely an Expanſion made.

Cupping-glaſſes.

4. (2.) In the caſe of Cupping-glaſſes, when the Glaſs and the Air it contains, are heated, the Glaſs is applied to the Skin; and ſoon after, the Air which was dilated by the Heat, gradually contracts itſelf, as the Heat decreaſes; upon which the Fleſh is thruſt into the Glaſs by the *Motion of Connexion* [x]. If it be deſired that the Cupping-glaſs ſhould draw ſtronger; let a Sponge be dipt in cold Water, and applied to the Belly of the Glaſs: for by this Coolneſs, the internal Air will be more contracted, and the Attraction of the Glaſs increaſed [y].

A hot Glaſs in Water.

5. (3.) If a Glaſs be heated, and inverted into Water, it will attract the Water; ſo as to fill a third part of the Cavity: whence 'tis plain, that the Air was rarified by the Heat, in that Proportion. But if, inſtead of a thin Glaſs, which will not bear a great Heat without danger of breaking; an Iron or Copper Veſſel were employ'd, and heated to a greater *degree*, we judge that Air might be dilated above twice or thrice more; which is an Experiment very well worth trying: as likewiſe, to aſcertain the degree whereto the Air may be rarified; that we may the better judge of its degree of Rarifaction in the upper Regions; and thence of the Æther itſelf [z].

Thermometer.

6. (4.) It appears very plain, from the Thermometer, that a ſmall increaſe of Heat may prodigiouſly expand the Air; ſo that the Hand laid upon the Glaſs, a few Rays of the Sun, or even the Breath of the Byſtanders, ſhall affect it: nay, the tendencies of the external Air to Cold and Heat, tho imperceptible to the Touch, do yet conſtantly dilate and contract the Air in the Glaſs [a].

Hero's *Altar.*

7. (5.) *Hero* deſcribes an Altar built ſo artificially, that when the Offering is light up thereon, Water ſhall of a ſudden deſcend, and put out the Fire.

[x] See this *Motion* explained in the *Novum Organum*, Part II. Sect. II. *Aph.* 48.

[y] This Explanation in ſome meaſure holds, notwithſtanding the preſent manner of accounting for Effects of this kind, from the direct preſſure of the Air without; and its Rariſaction within.

[z] See Mr. *Boyle's pneumatical Experiments* to this purpoſe.

[a] See this Weather-glaſs deſcribed, *Novum Organum*, Part II. Aph. 13. (38.)

Fire. No other Contrivance is requiſite to this Purpoſe, than to leave a cloſe hollow Space under the Altar, filled with Air; which being heated by the Fire, and conſequently dilated, ſhall find no exit but thro' a Pipe riſing along the Wall of the Altar; and having its Mouth bent down at laſt, ſo as to diſcharge upon the Altar. This upright Pipe was filled with Water; and had a belly in the middle, that it might contain the larger Quantity; and a Stop-cock at the bottom, to prevent the Water from falling thro'; which Stop-cock being turned, admitted the dilated Air to riſe up, and drive out the Water [b].

A heated Warming-pan applied to the Head in Apoplexies.

8. (6.) It was the Invention of *Fracaſtorius*, to recover Perſons from apoplectic Fits, by applying a heated metalline Pan, at ſome diſtance, round the Patient's Head; in order to dilate, excite, and revive the Spirits ſtagnating, congeal'd, or block'd up by the Humors, in the Cells of the Brain.

Warmth recovering Life.

9. (7.) Butterflies, and the like Creatures, which lie for dead in the Winter, recover Motion and Life by being warmed before the Fire; or by the Rays of the Sun. And Perſons in fainting Fits, are brought to themſelves by taking, internally, ſuch Liquors as are ſpirituous and heating, as well as by external Heat, Friction, and Motion.

Water how expanded by Heat.

10. (8.) *Water* opens, or expands itſelf, in the following manner. With the firſt Heat it emits a ſmall and rarified Vapour; without any other viſible Change in its Body. Upon continuance of the Heat, it does not riſe in its whole Body, nor in ſmall Bubbles, in the way of Froth; but aſcends in larger and rarer Bubbles, and reſolves itſelf into a copious Vapour; which, if not obſtructed, checked, or condenſed, mixes with the Air; being firſt viſible, but afterwards diffuſing itſelf, and becoming inſenſible.

Oil.

11. (9.) *Oil* opens itſelf thus. With the firſt Heat, certain little Drops aſcend; or ſmall Grains diffuſe themſelves thro' the Body of the Oil; and this with a ſmall crackling Noiſe: in the mean time, no Bubbles play upon the Surface, as in Water; nor does the whole Body ſwell, or emit any conſiderable Exhalation. But, after ſome Continuance, the whole Body riſes and dilates itſelf, very conſiderably; expanding, as it were, to double the Bulk: and going off in a very copious and thick Exhalation. This Exhalation, if it does not take Flame, at length mixes with the Air; as does the Vapour of Water. But Oil requires a greater degree of Heat to make it boil; and begins to boil much ſlower than Water [c].

Spirit of Wine.

12. (10.) *Spirit of Wine* rarifies, or opens itſelf, rather like Water than Oil: for it boils up in large Bubbles, without Froth, or Elevation of the whole Body; but it expands and flys off with a much leſs degree of Heat, and with much greater Velocity, than Water. It partakes both of an aqueous and oily Nature; readily mixes with Air; and ſuddenly takes Flame.

13.

[b] Here add the modern Contrivance of making *Jets d' Eaux*, and Fountains by the Spring of compreſſed Air.

[c] Lead melts at the Bottom of Oil, before the Oil begins to boil.

Vinegar and Wine.

13. (11.) *Vinegar*, *Verjuice*, and *Wine*, open themſelves differently in this reſpect, that Vinegar riſes in ſmaller Bubbles, and more about the ſides of the Veſſel; but Verjuice and Wine in larger Bubbles, and more in the middle of the Veſſel.

Unctuous Liquors.

14. (12.) In general, unctuous Liquors, as Oil, Milk, Fat, *&c.* riſe and ſwell in their whole Body, at once; whilſt ripe Juices, (and unripe ones ſtill more) riſe in larger Bubbles; but old and vapid Juices, in ſmaller.

Liquors in general.

15. (13.) 'Tis common for all Liquors, even Oil itſelf, before they boil, to throw, now and then, a few kind of half-Bubbles about the ſides of the Veſſel.

16. (14.) 'Tis likewiſe common for all Liquors to open themſelves ſooner, and to boil, and conſume, in a ſmall Quantity, than in a large one.

ADMONITION.

Experiments of the Rariſaction of Liquors, to be made in Glaſſes.

17. The Experiments about the opening of Liquors ſhould be made in Glaſs Veſſels; that the Motion in the Body of the Liquor may appear more viſible; and upon little Furnaces with equal degrees of Heat, that their Differences may be the more exactly noted. The Fire alſo muſt be gentle; becauſe when vehement, it hurries on and confounds the Actions of Bodies [d].

HISTORY.

Bodies fluid with Heat.

18. (1.) There are numerous Bodies, not of a liquid, but ſolid Conſiſtence, that by Heat acquire a degree of Fluidity, ſo long as the Heat continues to agitate and expand them; ſuch are Wax, Suet, Butter, Pitch, Roſin, Gums, Sugar, Honey, Lead, Gold, Silver, Braſs, Copper, *&c.* tho they require not only very different degrees of Heat to open them; but alſo different Modifications of the Fire and Flame. For ſome Metals melt over a common Fire; as Lead: others require a Fire animated by Bellows; as Gold and Silver; and others again, the admixture of certain Matters. So Steel does not melt without the Addition of ſome ſulphureous Body.

19. (2.) But if the Fire be continued briſk and ſtrong, all theſe Subſtances not only open by Colliquation; but alſo undergo a ſecond Opening, as that of Volatility, and Waſte, except Gold alone. Quickſilver, which is a natural Fluid, begins with this ſecond kind of Opening; and is eaſily volatilized. But with regard to Gold, it ſtill remains a Queſtion, whether it can be rendered volatile, pneumatical, or *potable*, as they call it; that is, not ſoluble, as by means of *Aqua regia*, which is a common and obvious Operation; but digeſtable, or alterable by the human Stomach. And the genuine Criterion of this Change is not, that the Gold becomes volatile in the Fire;

[d] A complete *Table* of this kind is ſtill wanting; and ſhould be derived from expreſs chemical Experiments.

Fire; but ſo ſubtile and attenuated as to be irreducible to Metal again [e].

20. (3.) Let farther Enquiry be made about Glaſs and vitrified Bodies, whether they are conſumable by Fire, and convertible into pneumatical Bodies: for Glaſs is accounted a fixed and juiceleſs Body; and Vitrification the Deſtruction of Metals [f]. *Glaſs, whether conſumable.*

21. (4.) All Bodies capable of Fuſion, begin the Proceſs of it from the loweſt degree of Opening; *viz.* Softneſs, and Suppleneſs, before they melt and run; ſuch as Wax, Gums, Metals, Glaſs, *&c.* *The firſt Proceſs of Fuſion.*

22. (5.) But Iron [g] and Steel, when perfectly purified and unmixed, bear a ſimple Fire, without proceeding farther than to a degree of Softneſs; ſo as to become malleable and flexible, but not fuſible, thereby. *Steel and Iron do not fuſe.*

23. (6.) Iron and Glaſs, when opened to the above-mentioned degree of Softneſs, ſeem to be dilated in their included Spirit; whence their tangible Parts are ſo wrought, as to lay aſide their Hardneſs, and Reſiſtance; tho the whole Body is not, at the ſame time, viſibly dilated, or ſwelled. But upon an exact Enquiry, there will be found a certain inviſible Tumefaction, and Agitation of Parts therein; tho this be reſtrain'd by their cloſe and compact Nature. For if throughly ignited Glaſs be laid upon a Stone-Table, or other the like Body, tho well heated before hand; the Glaſs will break, thro' the Hardneſs of the Stone reſiſting its ſecret Tumefaction: and therefore, in taking Glaſs out of the Melting-pot, in order to blow it, they uſually roll it upon ſome certain Powder, or ſoft Sand; which may gently give way, and not oppoſe this Tumefaction in the Parts of the Glaſs. *Glaſs how dilated by Heat.*

24. (7.) Bullets likewiſe ſhot from a Gun, after their projectile Motion entirely ceaſes, ſo as that, to the Eye, they ſhall ſeem perfectly at reſt; yet a great ſhuddering Motion, or Pulſation, will be found, in their ſmall Parts, for a long while after: inſomuch, that if any proper matter be laid upon them, it will thence receive and manifeſt a conſiderable Force; and this proceeds not ſo much from the burning Heat, as from the Tremor of Percuſſion. *Shuddering Motion in Bullets.*

25. (8.) Rods of Wood being freſh gathered, and kept turning in hot Embers, acquire a Softneſs; whence they may be bent at pleaſure. And this Experiment ſhould be tried in old Rods and Canes [h]. *Wood ſoftened by Heat.*

26. (9.) Combuſtible Bodies open ſo, as by Fire, firſt to emit a Fume; then to take Flame; and laſtly, fall into Aſhes. *Combuſtible Bodies how relaxed.*

27. (10.) Bodies which contain an aqueous Moiſture, that refuſes the Flame, and yet are cloſe and compact; as Bay-Leaves, Salts, *&c.* open by the Fire in ſuch a manner, that the aqueous and crude Spirit they contain, being dilated by the Heat, burſts out with a crackling Noiſe, before they take Flame: but if a Body at once emits a Flatulency, and takes Flame, a violent Tumult, and a powerful Dilatation enſues; that Flatulency, like *Flatulent Bodies.*

[e] This Point ſeems not hitherto ſettled to general Satisfaction.
[f] But improperly, as Metals are eaſily recoverable from their Glaſſes.
[g] *Viz.* hammer'd Iron.
[h] It has even been tried in large Timbers for Ship-building, with conſiderable Succeſs.

Bellows on the inſide of the Body, blowing and expanding the Flame every way, as in Gunpowder.

Bread. 28. (11.) Bread ſwells or riſes ſomewhat in the Oven; tho it loſes a little of its weight. And on the top of the Loaf ſometimes gathers a kind of cruſty Bubble, or Bladder; ſo that there remains a Cavity fill'd with Air, between the Pelicule of the Cruſt, and the ſecond Surface of the Loaf.

Roaſted Fleſh. 29. (12.) Roaſted Fleſh alſo acquires a degree of Tumefaction; eſpecially when the outward Skin is left upon it: as we ſee in roaſted Pigs, *&c.*

Fruits. 30. (13.) But roaſted Fruits ſometimes leap out of the Fire; as Cheſnuts: ſometimes burſt their Skin, and ſpirt out their Pulp; as Apples: and if ſcorched by the Fire, they acquire a burnt or ſcaly Cruſt; and, as in the abovemention'd Caſe of Bread, leave a Cavity between that Cruſt and the Fleſh of the Fruit. The ſame thing likewiſe happens in Eggs.

Baked Meats. 31. (14.) But if the Heat be ſlow, and without manifeſt Fire, and there be alſo no ready vent for the Vapour; as when Pears are roaſted in the warm Aſhes; and ſtill more remarkably when the Bodies to be treated are put into Pots, and then buried under the Aſhes, or ſet in the Oven, *&c.* in theſe Caſes the Tumefaction or Dilatation is repell'd, by the Heat, and turn'd back upon itſelf; whence enſues a Condenſation, as in Diſtillation; and the Body is more moiſtened, and, in a manner drowned with its own Juice: as appears in Pies, Tarts, and other Works of Paſtry and the Oven.

Dry Bodies. 34. (15.) But dry Bodies, if the Flame be ſuffocated and find no eaſy exit, become rarified, hollow, and porous; as we ſee in Charcoal, and the Pumice-Stones diſcharged from burning Mountains.

SECT. V.

Of DILATATIONS *by external* HEAT, *and* DISTILLATIONS.

Two kinds of Expanſion by Diſtillation. 1. THERE are two kinds of Dilatation, Opening, or Attenuation, of Bodies in Diſtillations; the one in Paſſage, when the Body is turn'd into Vapour or Fume, which is afterwards reſtored; the other in the Body ſo reſtored; which is always more rarified, more ſubtile and expanded than the crude Body from whence it was diſtill'd: as Roſe-water, for Example, is more rarified and light, than the Juice of Roſes.

The Action of Diſtillation. 2. All Diſtillation is perform'd by a kind of Flux and Reflux, or alternate Rarifaction and Condenſation; the one raiſing the Vapour, or rendering the Body pneumatical; and the other ſtriking it back, or reſtoring it to a tangible ſtate.

The Dilatation ſpurious in Diſtillation. 3. The Actions of Dilatation and Condenſation, are not pure in the Caſe of Diſtillations; but the Separation of heterogeneous Parts intervenes: which is the intentional Action with regard to Practice; whereby the purer Juices, the Phlegm,

Phlegm, the Oil, the fine Parts, and the groſs Parts of Bodies are ſeparated from each other.

4. Under Diſtillations 'tis proper to enquire into, and determine, the degrees and diverſities of Heats; as that of Coals, a hot Oven, that of Baths, that of Water, Aſhes, Sand, *&c.* that of the Sun, Horſe-dung, Fire left to itſelf, Fire animated by Bellows, Fire confin'd and reverberated, Heat aſcending, Heat deſcending, and the like; all which have a remarkable Efficacy in the opening of Bodies; and particularly in the complicate Actions of Dilatation and Contraction. For theſe Heats ſeem by no means to reſemble the Heat of the Sun, and celeſtial Bodies; neither in gentleneſs, ſoftneſs, temperature, continuance, refraction, modification by intermediate Bodies; nor in ebbing and flowing, with the remarkable inequality of Day and Night. But all theſe particulars ſhou'd be diligently examin'd, under the general Titles of *Heat* and *Cold*; with their ſubordinate Diviſions [k]. *Different Heats.*

5. Diſtillations, and the Dilatations they cauſe, are perform'd in a cloſe Veſſel; where the Body to be diſtill'd, the Vapours it affords, and the Air, are ſhut up together: for in the common Stills and Alembics, the external Air is not excluded from entering, in ſome degree, the Pipe of the Still-head, or Noſe of the *Worm*. But in Retorts, where a ſtronger Heat is required, the external Air has no Entrance; the Mouth of the Receiver being join'd by a Luting to the Neck of the Retort; ſo that the whole Proceſs of Rariſaction and Condenſation is perform'd within. But if the Body be full of a vigorous Spirit, as Nitre or Vitriol, it requires a capacious Receiver; that the Vapours may freely play about therein, without burſting the Glaſs. *The Proceſs of Diſtillation.*

PRECEPTS.

6. (1.) But tho Diſtillations are perform'd, as it were in a cloſe Cell; yet there is ſtill Space enough allowed for ſome parts of the Body to expand into Vapour, and other Parts to ſubſide in Fæces; and again, for the Vapours to wind and roll about, reſtore themſelves, and, when of different Natures, to ſeparate one from another. The following *Precept*, therefore, is of the utmoſt importance; as it may advance a Method of putting Nature to the Scrutiny, and producing new Transformations: for the Fire of the Chemiſts and Phyſicians, tho it has produced many uſeful Things; yet does not, perhaps, obtain the more genuine Virtues, and Properties of Heat, by reaſon of the Diſtractions and Separations of the Parts, which conſtantly happen in their Operations. The Sum of our *Precept*, comes to this, that all Separation, and all Flux and Reflux of Rarification and Condenſation, be totally prohibited; and that the Heat be ſpent entirely within the Body itſelf, and its Cavities. Such a Method may poſſibly hold the *Proteus* Matter, bound and manacled; and compel it to try all its Shapes and *Diſtillations improved, for the buſineſs of Converſions.*

[k] See Mr. *Boyle*'s Hiſtory of Cold; and the Chapter of Fire in Dr. *Boerhaave*'s Chemiſtry.

Converſions, in order to free and clear itſelf. Numerous Inſtances occur to us, with regard to this Affair; and others may be diſcovered: but we will here propoſe only an eaſy Example or two, the more fully to expreſs our meaning.

A new Digeſtor applied; by an Example, in Wood.

7. (2.) Having provided a cubical Veſſel of Iron, the ſides whereof are very ſtrong and thick; fit a Cube of Wood exactly to it, ſo as perfectly to fill the Cavity: then, in the ſecureſt manner, fix and lute on a ſtrong Cover of the ſame Metal, ſo as not to give the leaſt vent; but remain capable of bearing the Heat. Now place the Veſſel in the Fire, and there continue it for ſome Hours; afterwards take off the Cover, and examine what Change the Wood has ſuffered. It ſhou'd ſeem, that as the Wood in this Caſe, cou'd neither flame nor emit a Fume, ſo as to diſcharge any of its pneumatical or moiſt Parts; the Body of the Wood muſt either be converted into a kind of Amalgam; or reſolved into Air; that is, a truly pneumatical Body; leaving at the bottom, certain feculent Parts, groſſer than Aſhes; and ſome Incruſtation on the ſides of the Veſſel [l].

Water in Confinement.

8. (3.) Let Trial alſo be made of a quantity of pure Water, that ſhall perfectly fill a like kind of Iron-Veſſel: but here the Fire ſhou'd be more gentle; and the Operation of longer Continuance. The Veſſel alſo might be removed from the Fire at certain Hours; and afterwards put on again: and this for ſeveral times. We make Choice of pure Water for this Experiment, becauſe Water is a ſimple Body, without Colour, Smell, Taſte, or other remarkable Qualities. And, therefore, if by a mild and gentle Heat, an interchange of heating and cooling, and a prevention of all Evaporation, the Spirit of the Water ſhall not be loſt, but ſtill be wrought upon, and become attenuated by this kind of Heat, ſo as to turn itſelf upon the groſſer Parts of the Water, and digeſt and change them into a new Texture and Arrangement, of greater Simplicity and Uniformity; the Water thus acquiring either a different Colour, Smell, Taſte, a degree of Oilineſs, or any other conſiderable Alteration, like what we find in compound Bodies; doubtleſs it wou'd prove a great Acquiſition, and open a way to numerous Particulars of moment [m].

And made general.

9. (4.) In this Method of *cloſe Diſtillation*; that is, where no Space is allow'd for Evaporation; any one may eaſily invent many other Experiments. And this we are certain of, that a ſuitable Heat operating upon a Body, without ſeparating or conſuming its Parts, may produce wonderful Effects and Changes of Structure [n].

10. (5.) We

[l] The Experiment ſeems to have never been tried; on account, perhaps, of the Danger that may be apprehended from the burſting of the Veſſel. But any Inconveniences of this kind might be prevented by an Artiſt.

[m] Becauſe it wou'd then afford a practical Inſtance of the Tranſmutability of Bodies. See the *Sylva Sylvarum* paſſim.

[n] It ſhou'd ſeem that great Light may be derived to Philoſophy from this kind of *Digeſtor*, as there has been from the Air-Pump, Teleſcope, *&c.* See Dr. *Papin*'s Account of his Digeſtor; and let the Contrivance be improved, transfer'd, and varied; and a proper Set of *Leading Experiments* be tried both upon this, and other kinds of *Digeſtors*.

10. (5.) We might add, as an *Appendix* to this *Precept*, that ſome Method ſhou'd be diſcovered (which certainly is not difficult) whereby Heat may operate, not only in a cloſe, but in a tenſile, or extendible Veſſel: which is the Caſe in a every natural Matrix, whether of Vegetables or Animals. For ſuch an Operation extends to many Things, not performable by ſimple Confinement. This Contrivance does not regard the *Pygmy of Paracelſus*, or any ſuch monſtrous Trifles; but Things of Weight and Solidity. For Example, *cloſe Diſtillation* can never make a total Converſion of Water into Oil; becauſe Oil poſſeſſes more Space than Water: but if the Operation were performed in an extendible Body; perhaps this Transformation might be effected: which wou'd be a Thing of prodigious Uſe; as all Alimentation principally depends upon Fat [o]. *Operations to be perform'd in extendible Veſſels.*

11. (6.) 'Twere a proper and very uſeful Thing, ſometimes in Diſtillations to compel Nature to an Account; and take a juſt eſtimate of the quantity loſt in the Operation: that is, of the quantity grown pneumatical; and again of the remaining Part, whether fix'd or reſtored in the Body. This may be done by firſt weighing the Body to be diſtill'd, and the Veſſels wherein the Operation is to be perform'd; and after the Operation is over, weighing the diſtill'd Liquor, the Fæces, and laſtly the Veſſels again: by which means may be learn'd what proportion was reſtored; what proportion remain'd in the Fæces; and what adhered to the Veſſels: and the deficiency of the three ſeveral Weights, compared with the Weight of the whole Body, will ſhew what Proportion was rendered pneumatical [p]. *The Matters loſt in Diſtillations to be eſtimated.*

SECT. VI.

Of the DILATATIONS *and* RELAXATIONS *of Bodies by the Remiſſion of Cold.*

TRANSITION.

1. WE proceed from the Dilatations and Rarifactions cauſed by actual Heat, to the Dilatations and Relaxations produced by the Remiſſion of violent and intenſe Cold: and this Remiſſion ſhou'd be eſteem'd a comparative degree of Heat.

2. (1.) Bodies froze by violent Cold; but not ſo far as, by the continuance of the Cold, to remain fix'd in their Condenſation; open and reſtore themſelves without manifeſt Heat; and barely upon a remiſſion of Cold: as in Ice, Hail, Snow, *&c.* but they do this much quicker upon the application of manifeſt Heat. *Bodies froze and thaw'd.*

3. (2.) But

[o] See the *Sylva Sylvarum* paſſim.

[p] Something of this kind has been done by M. *Lemery* in his *Courſe of Chemiſtry*; but Mr. *Hales* in his *Vegetable Staticks*, has proſecuted the Thing with great Exactneſs; and more directly to the preſent purpoſe.

Fruits. 3. (2.) But the more delicate Substances, whose Vigour consists in a subtile native Spirit; as Apples, Pears, Pomegranats and the like; have their Spirit suffocated by Congelation; so as not again to recover their pristine Vigour upon Thawing [q].

Liquors. 4. (3.) Wine likewise, and Malt Liquors, grow flat to the Taste, and lose of their Vigour upon freezing: Yet they revive, relax, and as it were ferment again after thawing, when the Weather becomes warm, and the Wind Southerly [r].

SECT. VII.

Of the DILATATION *and* RELAXATION *of Bodies by potential Heat; or the auxiliary Spirits of other Bodies.*

TRANSITION.

Instances of potential Heats to be derived from medicinal History. 1. AS to the Subject of *potential Heats*, 'tis proper to consult the *medicinal Tables of secondary Qualities*; which exhibit the Things that operate by *Dilatation*, upon the human Body: and they are in general such as these.

VIZ.

Medicines acting by Dilatation.

2. (1.) *Cardiacs*, which dilate the Spirits oppress'd.
(2.) *Abstergents*, which strengthen the expulsive Faculties.
(3.) *Aperients*, with regard to the Orifices of the Veins and Vessels.
(4.) *Aperients*, with regard to the Pores and Passages of the Parts.
(5.) *Digestives*, which ripen at the same time.
(6.) *Digestives*, which discuss at the same time; and,
(7.) *Caustics*, which burn and consume the Flesh.

Their manner of Action. 3. These Things have their Effect principally by dilating the Spirits, Humours, Juices and the Substance of the Body, by means of auxiliary Spirits; and again by a stimulating Virtue which such Medicines have in contact with the Parts of the Body, whether used internally or externally.

SPECULATION.

The Spirits more sensible of Heat than Air. 4. It appears from the Weather-glass what an exquisite Sense, or Perception, the common Air has of Heat and Cold; as immediately shewing the most

[q] Unless thawed by being put into cold Water.
[r] The Particulars wanting in this Section, may in great Measure be derived from Mr. *Boyle's Experimental History of Cold.*

moſt ſubtile Differences and D egrees thereof. And we judge, that the Perception of the Spirits in Animals, as to Cold and Heat, is much more acute and ſubtile: only the Air is a pure and genuine pneumatic Body, that has no tangible Parts mix'd among it; and the Perception of the Spirits is dull'd and blunted by the tangible Body in which they are detain'd. But notwithſtanding this Impediment, the Spirits of living Creatures ſeem more delicate, or ſenſible, than the Air itſelf: for it has not hitherto appeared, that potential Heat can cauſe a Dilatation of the Air; whereas it certainly has that Effect upon the Spirits contain'd in the Parts of Animals: which is manifeſt from the ſecondary Qualities of Medicines. But of this let farther Enquiry be made; according to the following *Precept*.

PRECEPT.

Whether the potential Heat of Spirit may rarify.

1. Take two Weather-glaſſes, of the ſame ſize; fill the one with Water, and the other with rectified Spirit of Wine; heat the Glaſſes in ſuch a manner, that both the Water and the Spirit may ſtand at the ſame height; then place them together, leave them a time, and obſerve if the Water ſtand higher than the Spirit: for if it does, 'tis plain that the potential Heat of the Spirit of Wine expands the Air, ſo as to depreſs the Spirit [f].

That ſecondary Qualities may act upon inanimate Bodies.

2. It might be very uſeful, ſometimes to try and exerciſe the Operations of the ſecondary *medicinal Qualities* in lifeleſs Bodies. For altho no Effect cou'd be expected from moſt of them; as a living Spirit is abſolutely required to actuate them, on account of the ſubtilty of the Operation; yet others of them wou'd doubtleſs have an Operation upon ſome inanimate Bodies. Thus, we ſee what Effect Salt has upon Fleſh, Spices upon dead Carcaſſes, Rennet upon Milk, Leaven upon Bread, *&c.* The diligence therefore of Phyſicians, as to their ſecondary Qualities, may, if judiciouſly conſidered and transfer'd, ſerve in performing numerous other Operations: always ſuppoſing that a ſtronger virtue is required to operate upon a dead Body than a live one [g].

SECT.

[f] The difference may proceed from the Spirit of Wine being more rarifiable by the warmth of the external Air, than Water; but whether Rarifaction be the *Form* of Heat is not hitherto ſatisfactorily determin'd. See the *Novum Organum*, Part II. *Aph.* 12, *&c.*

[g] The proper Uſe ſeems not hitherto made of this *Precept*.

SECT. VIII.

The Hiſtory of DILATATION *in Bodies, by a Releaſement of their Spirit.*

TRANSITION.

The Spirits of Bodies how releaſed.

1. WE come next to the Dilatations of Bodies made by a Releaſement of their Spirits, upon breaking the Priſon of the groſſer Parts, which cloſely detain'd them, ſo that they cou'd not dilate: for in Bodies which have a compact cloſeneſs, and remain ſtrongly bound together in their wholes, the Spirits cannot perform their Office of dilating; unleſs there be firſt a Solution of Continuity in the groſſer Parts, made either by corroſive Liquors, with or without the aſſiſtance of Heat: and this appears in the opening and diſſolving of Metals.

Ductility of Gold.

2. (1.) A Penny-weight of pure *Gold* may be reduced, by the Hammer, into thin Plates; ſo as to be readily torn betwixt the Fingers.

Gold diſſolved in Aqua regia.

3. (2.) If the Gold be now put into a Glaſs, with four times its quantity of *Aqua regia*, and the Glaſs be ſet over a very ſoft and gentle Fire; there will ſoon appear to ariſe therein certain little Grains, which, after a ſmall Continuance, diffuſe themſelves and incorporate with the Liquor; ſo as to render it bright and ſhining; as if tinged with Saffron. But the Gold, in the Proportions here ſet down, diſſolves only to a third; for the Menſtruum will imbibe no more: ſo that if the whole Penny-weight of Gold were to be diſſolved, the ſaturated Menſtruum muſt be poured off; and again four Penny-weight of *Aqua regia* poured on; and ſo for the third time. This Diſſolution proceeds calmly, and ſlowly, in a moderate Heat, without Fumes, and without heating the Glaſs, more than what the Fire occaſions.

Quickſilver diſſolv'd in Aqua fortis.

4. (3.) To a quantity of crude *Quickſilver*, put into a Glaſs, add twice its weight of *Aqua fortis*; and without ſetting the Veſſel to the Fire, there will preſently riſe up ſomething like a very fine Powder, in the Body of the Liquor; and in the ſpace of an Hour, without Fire, without Fumes, and without Tumult, the Mixture will appear a clear uniform Liquor.

Lead.

5. (4.) Put a Penny-weight of thin plated *Lead* to nine Penny-weight of *Aqua fortis:* the Lead will not here incorporate ſo well as the other Metals; but the Menſtruum throws down the greater part of the Lead, in form of a *Calx*, to the bottom; the Liquor above, remaining ſomewhat turbid, tho tending to tranſparency.

Silver.

6. (5.) To a Penny-weight of plated *Silver*, add four Penny-weight of *Aqua fortis*; ſet them in a gentle Heat: and the Silver will riſe within the Body of the Liquor, like ſmall Sand, or Bubbles, a little larger than thoſe of Gold; and incorporate with the Menſtruum, and turn with it into a thin, white, and as it were milky Liquor: but after ſtanding and cooling for a while,

icy

icy Plates appear to ſhoot in the Body of it, proceeding from the mixture of the Metal and the Menſtruum: but when, after a longer ſtay, the Separation is totally made, the Liquor becomes clear and cryſtalline; throwing the icy Plates to the bottom. The Menſtruum here ſuſtains the full weight of the Metal; as in Gold; and the Diſſolution is made almoſt with the like Heat; and does not increaſe it by Motion, any more than in the caſe of Gold.

7. (6.) Six Penny-weight of *Aqua fortis* being put to one Penny-weight of *Copper*-Filings, and ſet in a Sand-heat; the Copper riſes in larger Grains, or Bubbles, than Silver; and ſoon after incorporates with the Menſtruum into a blue turbid Liquor; but upon ſtanding, it brightens up, like the Sky, into a ſhining beautiful Blue; throwing down the Fæces, in form of Powder, to the bottom; which Fæces, however, are diminiſh'd in time, and aſcend and incorporate with the reſt: and thus ſix Penny-weight of *Aqua fortis* diſſolves one Penny-weight of Copper, entirely; ſo that the Menſtruum here ſuffers itſelf to be charged with twice the weight it did in the caſe of Gold and Silver. But the Solution of Copper conceives a manifeſt Heat, by the internal Conflict, even before it is applied to the Fire. *Copper.*

8. (7.) Three Penny-weight of *Aqua fortis* being added to one Penny-weight of *Tin*-Filings, the whole Metal is turn'd into a Body like Cream or Curds, which does not readily clarify itſelf; but conceives a manifeſt Heat without Fire. *Tin.*

9. (8.) Nine Penny-weight of *Aqua fortis* being poured upon one of *Iron* Filings, the Metal, without Heat, riſes up in large Bubbles; not only within the Body of the Liquor, but above it; ſo as to boil out at the mouth of the Glaſs: at the ſame time emitting a copious, denſe and Saffron-coloured Fume; with a violent Conflict, and a great degree of Heat, inſufferable to the Hand. *Iron.*

ADMONITION.

10. No doubt but the different Properties of different Menſtruums, and the manner of applying the Fire or Heat, may cauſe ſome Alterations in the form wherein Metals open themſelves. *Metals open differently in different Heats.*

PRECEPT.

11. (1.) Obſervation ſhou'd be made, what kind of Dilatation happens in the opening of Metals; as whether it be like that of Leaf-Gold, which is a ſpurious Rarifaction, wherein the Body is dilated rather in Place than Subſtance, after the manner of Powders; or whether the Body of the Metal be actually dilated in Subſtance. This may be determined by the following Experiment. Take an exact weight and meaſure of Quickſilver, and ſo of *Aqua fortis*, after the manner of our *firſt Table*; then make a Solution thereof, and weigh it in the two Veſſels, wherein the Quickſilver and *Aqua fortis* *To try whether Metals be dilated in Subſtance.*

were ſeparately weigh'd; and obſerve whether the weight and meaſure of the Compound exactly anſwer to the weight and meaſure of the ſame Bodies, when ſeparate. We make choice of Quickſilver for this Experiment, becauſe, as it diſſolves without Fire, there is the leſs Suſpicion of waſte[t].

Whether metallic Solutions may ſupport Metals.

12. (2.) It ſhou'd be obſerved, whether a Solution of Quickſilver may not ſupport the heavieſt Stones, or even Tin, ſo as to keep them floating. This might be collected from knowing the Proportions of their ſpecific Gravities. And let not this be ſuſpected as tending to Miracle and Impoſture; but only to the Inveſtigation of the Nature of Mixture[u].

OBSERVATION.

Metals diſſolving like Sand.

13. 'Tis worth obſerving, that all Metals, tho remarkably heavier than the Menſtruums in which they diſſolve, yet aſcend in the form of Sand or Bubbles, during the firſt act of Solution: and this is the more conſiderable where they do the ſame without Fire, as in the Caſe of Quickſilver.

SPECULATION.

Intimation of the Cauſe of Solution.

14. The Tumult happening among the Parts of the Bodies in the Diſſolution, is the Cauſe that the Metals aſcend in this manner: for Bodies are ſomewhat impell'd by a local Motion in all violent Corroſion; as plainly appears from little gravelly Stones, which being put into ſtrong Vinegar, on the ſides of a Porringer, that they may eaſily ſlide; continue moving, or as it were, ſwiming by Fits, like little Fiſh. There is alſo a kind of Stone, or Foſſil, which, when put into Vinegar, moves and runs up and down therein, with a reſtleſs Motion. But the Bodies that mix without this Tumult, do not perhaps readily aſcend, without ſhaking: So Sugar diſſolving at the bottom of Water, does not dulcify at the top; nor Saffron, in like manner, tinge, without Commotion and Agitation[v].

SECT.

[t] Some attempt of this kind was made by Dr. *Hook*, and Dr. *Grew*; but the matter, perhaps, has not been duly proſecuted.

[u] See Dr. *Grew*'s Diſcourſe concerning the *Nature*, *Cauſes* and *Power* of *Mixture*.

[v] See Mr. *Boyle* upon *Fluidity and Firmneſs*.

SECT. IX.

The History of DILATATION, *upon the meeting and uniting of Bodies related.*

TRANSITION.

1. WE muſt next come to another kind of Dilatation, commonly call'd by the Name of *Diſſolution*, in ſome Caſes. This happens where Bodies run into the Embraces of one another, and, if poſſible, open themſelves, ſo as to receive each other internally. But this Relaxation does not happen with any Tumult, or by the Penetration of the entring Body, as Menſtruums penetrate Metals; but calmly, and by a Relaxation of the receiving Body. *The Dilatation of correſponding Bodies explain'd.*

2. (1.) Sugar and ſome Gums, viz. Gum Tragacanth, Gum Arabic, *&c.* being put into Water, reſolve; as willingly relaxing their Parts, like a Sponge, to receive the Liquor in amongſt them. *Inſtanced in Sugar and Water.*

3. (2.) Paper, Fur, Wool, and the like porous Bodies, being plunged in aqueous Liquors, or otherwiſe moiſten'd, open themſelves, ſo as to become more ſoft, yielding, ſeparable, and as it were putrefied. *Paper, &c.*

4. (3.) Sudden Joy remarkably dilates the Spirits of Men; as upon the hearing of good News, ſeeing the Object deſired, *&c.* and tho there be here no Contact of Bodies; but only an Act of the Imagination; yet this Act is ſometimes ſo powerful, as to endanger ſudden Fainting, or even Death itſelf. And ſomething of the like kind happens when the Imagination is earneſt upon venereal Pleaſures. *Dilatation upon Joy.*

PRECEPT.

5. All endeavours ſhou'd be uſed, to diſcover peculiar Menſtruums for each particular Subſtance; ſince, in all probability, there are Liquors, and ſoft pappy Bodies, that have ſuch a Sympathy, or Correſpondence, with particular Matters, that upon the Application thereof they will readily relax their Parts, willingly imbibe the others, and thus become mollified and renewed in their own Juices. And this regards one of the Capital Things in all Nature; *viz.* the refreſhing, and recruiting the moſt radical and eſſential Moiſture of Bodies from without; ſuch as Fleſh, Bone, Membranes [w], Wood, *&c.* So likewiſe there is a Sympathy, or Correſpondence, in the Bodies which operate by Divulſion, and Penetration: for *Aqua fortis* does not diſſolve Gold, nor the common *Aqua regia* Silver [x]. *Particular Menſtruums for particular Subjects.*

[w] See the *Hiſtory of Life and Death*, paſſim.

[x] Upon finding out theſe *Sympathies*, or *Relations*, betwixt Bodies, and the Menſtruums they indicate, the perfection of *Chemiſtry*, and a large part of *Natural Philoſophy*, ſeems to depend.

SECT. X.

The History of DILATATION *by* ASSIMILATION, *or the Conversion of a grosser Matter to such as is more subtile.*

TRANSITION.

Dilatation by Assimilation, how produced.

1. WE next pass on to the *Dilatation by Assimilation*, or *Conversion*; wherein the over-ruling, and more active, Body subdues the other that is more obsequious and passive; so as actually to turn that into itself, and multiply and renew its own Substance thereon: but if the Body thus assimilating be more subtile and rarified than the Body assimilated, this *Assimilation* of necessity produces Dilatation.

Air assimilates Moisture.

2. (1.) Air licks up the humidity of the Earth, preys upon it, and converts it into itself; but chiefly when in Commotion, as in the Case of Winds [y].

3. (2.) The Process of Desiccation in Woods, Plants, *&c.* that are not very hard, or stubborn, turns upon the Depredation of the Air; which draws out, sucks up, and turns to its own Substance, the Spirit of the Body: whence this Process proceeds but slowly in fat, and oily Bodies; because their Spirit, and Moisture, are not so nearly of the same Substance with the Air.

Spirit assimilates a grosser Matter.

4. (3.) The Spirits of tangible Bodies feed and prey upon the grosser Parts of the Body that includes them: for the Spirits which approach nearest to Air, obey its Call, and go forth suddenly; but those which reside deeper in the Body, prey upon the more internal Parts that lye contiguous, beget new Spirits thereon, join these to themselves, and at length fly off together: whence such Bodies by Age, or long lying, diminish in their weight; which cou'd not possibly happen, unless some tangible Part were gradually converted into an untangible or pneumatical one; for Spirit once formed in a Body, has no longer any Gravity in that Body, but rather helps to lighten it [z].

Tumours discuss'd by Perspiration.

5. (4.) Many Tumours in the Bodies of Animals are discuss'd by *insensible Perspiration*, without Suppuration; and render'd perfectly pneumatical, subtile, and perspirable.

6. (5.) Fla-

[y] See the *History of Winds*, passim.

[z] If this be meant of specific Gravity; or supposing the Body weigh'd in Air; it may be readily allowed: but if meant of absolute Gravity, or supposing the Body weigh'd in a *Vacuum*; it will perhaps require more exact Experiments to determine it.

6. (5.) Flatulent Eatables produce Windineſs in the Body; their Juices being converted into Flatus, and Air; which eſcape by Eructation and otherwiſe: tho ſometimes not without extending, and griping, the internal Parts. The like alſo ſometimes happens from the moſt approved Aliment, by reaſon of a weakneſs in the digeſtive Faculties. *Wind generated in the Body.*

7. (6.) In every Body requiring Aliment, when the Parts nouriſhed are finer or more ſubtle than the Nouriſhment; Alimentation muſt neceſſarily cauſe a Dilatation. Thus the Spirits and Juices of Animals are lighter than the Solids, or Liquids, that nouriſh and ſupply them. *Alimentation cauſes a Dilatation.*

8. (7.) Of all Openings, Dilatations and Expanſions, the greateſt in proportion to the Body before and after the Dilatation, the quickeſt, and of leaſt Duration, is that of oily and inflammable Bodies into Flame; which ſeems to be done copiouſly, and at once, without ſtop or degree. And here the Succeſſion of the Flame is plainly a kind of Aſſimilation; whilſt the Flame multiplies itſelf upon its Fewel. *Oil expanded into Flame.*

9. (8.) But the moſt powerful Thing of this kind, not with regard to the ſuddenneſs of firſt catching Flame (for Brimſtone, Camphire, or Petreol catch Flame ſooner than Gunpowder) but with regard to the Succeſſion of the Flame once caught; and overcoming all Reſiſtance; is that mixed Expanſion beforementioned, of Gunpowder into Flame and Air; as in the firing of Cannon; the blowing up of Mines, *&c.* *Gunpowder into Flame and Air.*

10. (9.) The Chemiſts obſerve a very violent Expanſion of Quickſilver by the Fire, and alſo of a preparation of Gold; ſo as to explode in a dangerous manner; and give a report like that of a Gun[a]. *Quickſilver and Gold expanded.*

SECT. XI.

Of DILATATIONS, *or* DISTRACTIONS, *by external Force.*

TRANSITION.

1. WE ſhou'd next proceed to thoſe Dilatations, Diſtractions, or Divulſions, that proceed not from any Appetite in the Body dilated; but from the Violence of external Bodies, which, prevailing with their Motions, lay the Body under a Neceſſity of being dilated, or ſtretched. This Enquiry, however, belongs to the *Title of free Motion*; but, as in the former Caſes, ſo we ſhall here alſo add ſomewhat upon this Head. The Motion we ſpeak of is generally of two kinds; the one being a Motion of *Diſtraction*, from external Force; and the other a Motion of *Contraction*, or Reſtitution, proceeding from the Motion proper to the Body. *The Motion of Dilatation double.*

[a] Viz. the *Aurum Fulminans.*

dy. This latter Motion, tho it belong to Condenſation, is yet ſo join'd with the former, that it may commodiouſly be treated in this place.

Bent Rods. 2. (1.) Rods of Wood, and the like, ſuffer ſome degree of forcible Bending; which draws the external Parts aſunder in the bent place; and compreſſes the internal Parts. If the bending Force be ſoon after remitted; the Rod flies back and reſtores itſelf: but if the Rod be long detain'd in that curved Poſition, it fixes there, and ſtarts back no more.

Watch-Springs. 3. (2.) The Caſe is the ſame in Watch-Springs; where the piece of coiled Steel has a conſtant and gradual endeavour to unwrap or reſtore itſelf.

Cloth. 4. (3.) Cloth, and the like Subſtances conſiſting of Threads, receive a great degree of Extenſion; and reſtore themſelves, if ſoon let go; but not if they have remain'd long ſtretch'd, or tentered.

The Fleſh in Cupping-Glaſſes. 5. (4.) The Fleſh which riſes upon the application of a Cupping-Glaſs, is not a Tumor; but a violent extenſion of the entire Fleſh, by Attraction [b].

The Rariſaction of the Air. 6. (5.) The following Experiment may ſerve to diſcover what degree of Rarifaction the Air is capable of. Take a Glaſs-Egg, with a ſmall Hole in it; ſuck out the Air as much as poſſible; then immediately cloſe the Orifice with the Finger; plunge the Egg, thus ſtopp'd, under Water, and now the Finger being removed, the Egg will draw in as much Water; as there was Air ſucked out: ſo as that the remaining Air will recover its former Expanſion, from which it was forcibly drawn and extended [c]. And, as I remember, the Egg drew in about a tenth Part of its own content of Water. I likewiſe left a Glaſs-Egg thus evacuated, and ſtop'd up with Wax, a whole Day, to try if dilated Air might be fix'd by time; ſo as no longer to reſtore itſelf, like Wood or Cloth: but when the Wax was removed, the Water entered in as before; and even when unſtop'd in the open Air, new Air enter'd at the Orifice, with a hiſſing Noiſe. But the time was here too ſhort for an accurate Experiment [d].

Of Water. 7. (6.) What degree of Rarification Water is capable of, may perhaps be thus diſcovered. Take a pair of Bellows, and draw up as much Water with them as may fill their Cavity; tho without raiſing the Bellows to their height, or but, as it were, half way. Then ſtop up the Bellows; and ſtill continue to raiſe them by degrees; to ſee how far the Water received will ſuffer itſelf to be dilated: or otherwiſe, draw up Water by a Pipe, or Syringe; then cloſe the Orifice; and gradually raiſe the Embolus, or Sucker, ſtill higher [e].

* *SPE-*

[b] See above, *Sect.* IV. 4.

[c] Mr. *Boyle* has ſeveral appoſite Experiments to this purpoſe.

[d] This Experiment has been proſecuted by Mr. *Boyle*, Mr. *Hauksbee*, and others, by means of the *Condenſer*, an Engine, which is the Converſe of the *Air-Pump*. But it, perhaps, deſerves to be carried ſtill farther; by means of a ſtronger *Condenſer* than the common; a greater condenſing Power than that of a Syringe, work'd by human Strength; a much longer time of Reſt being alſo allow'd.

[e] This Experiment may perhaps be better tried in the exhauſted Receiver of the Air-Pump; by including a ſpherical Glaſs of Water therein; with a long and ſlender Neck: for when the

SPECULATION.

8. We ſuſpect that the Spirit of Water [f] ſuffers ſome Diſtraction in Congelation; tho this ſeems a very ſubtile Affair. But firſt, 'tis certain, that in all baking or burning, as in the baking of Bread, the burning of Brick, *&c.* a large proportion of the pneumatical part of the Body flies off, and exhales: whence, of neceſſity, the groſſer Parts contract themſelves, in ſome meaſure; by the *Motion of Connexion* [g]: for when the Spirit is gone off, and no other Body eaſily enters to poſſeſs the place deſerted by the Spirit, the Parts come cloſer together, to prevent a *Vacuum*, as they phraſe it; whence proceeds Hardneſs and a Contraction of the Body. So on the contrary, it ſhou'd ſeem that the Spirits of Bodies are drawn aſunder by freezing; for the groſſer Parts are contracted by Cold; ſo that there is left ſome ſpace unoccupied within the Cells of the Body: whence it follows, that if no other Body ſucceed, the inherent Spirit muſt be ſtretched or diſtracted, by the *Motion of Connexion*, as much as the groſſer Parts are contracted. And this appears to be the Caſe in Ice; the Body whereof is full of Cracks and Blebs, and ſomewhat ſwelled; whilſt the Ice itſelf, notwithſtanding the remarkable Contraction of its Parts, is in its Whole, ſpecifically lighter than Water: which may, perhaps, be juſtly attributed to the Dilatation of its pneumatical Parts [h].

Contraction and Congelation explain'd.

SECT. XII.

Of DILATATIONS *by Diffuſion, or Spreading.*

TRANSITION.

1. WE come next to the *Dilatations by Diffuſion*, when a Body heap'd up and preſs'd together, is ſpread out into a Plane or Flat. But this kind of Dilatations is to be accounted ſpurious; as being made, not in the Subſtance of the Body, but in the poſition of its Parts: for the Body here remains in the ſame Denſity of Subſtance, only acquires a larger Figure in Surface, and a leſs in Solidity.

Dilatation by Diffuſion, ſpurious.

2. (1.) Gold

the preſſure of the Atmoſphere is taken off, the Water will ſwell and riſe viſibly in the Neck of the Glaſs. Or it might be proper to try how far Water expands by a boiling Heat; and how far when converted into Vapours. For all which let Mr. *Boyle*, and farther Experience be conſulted.

[f] That Water has a Spirit, ſee confirm'd and illuſtrated in Dr. *Hoffman's New Experiments and Obſervations upon Mineral Waters.*

[g] See *Nov. Organ.* Part II. Sect. II.

[h] Compare this with the *Speculations* of Mr. *Boyle* and Dr. *Hoffman* upon the ſame Subject. See alſo below, *Sect.* XV. 24.

Ductility of Gold.

2. (1.) Gold acquires an immenſe Dilatation by the Hammer, as we ſee in Leaf-Gold; ſo again by Drawing, as we ſee in the Gilding of Silver-Wire: for the Maſs of Silver is gilt over, before 'tis drawn out into Wire [i].

Silver.

3. (2.) Silver alſo is, by the Hammer, reduced to Leaves; tho not ſo exquiſitely thin, as Gold. The other Metals alſo may be hammered into thin Plates.

Wax.

4. (3.) Wax, and the like Bodies, may be formed, moulded, and wrought into thin Cakes, Caſes, or Coverings [k].

Ink.

5. (4.) A Drop of Ink in the Pen is dilated, and ſpread out into a great number of Lines and Letters: and the ſame holds true of the Paint of a Painter's Bruſh, Varniſh, *&c.*

Saffron.

6. (5.) A ſmall Quantity of Saffron tinges a large one of Water [l]. And thus much for the Dilatations, Rarifactions, and Relaxations of Bodies.

SECT. XIII.

Of CONTRACTIONS *by the Emiſſion or Diſcharge of a* BODY *received.*

TRANSITION.

Contraction, and Condenſation to be treated ſeparate.

1. WE muſt next, with the like Diligence, enquire into the Actions contrary to the foregoing; *viz.* into the *Contractions*, *Condenſations*, and *Cloſures* of Bodies. And it ſeems beſt to treat this Buſineſs apart; the rather, becauſe all the Actions are not here reciprocal; but ſome of them peculiar, that require to be explained by themſelves. And altho they may agree in a contrary reſpect, yet they are diſcovered and exhibited by very different Experiments.

Contraction by Expulſion, reciprocal to Dilatation by Introſuſception.

2. The *Action of Contraction*, by the Emiſſion or Expulſion of another Body, is reciprocal to the Action of Dilatation, by the Introſuſception of another Body; and therefore this muſt be firſt enquired into.

3. (1.) Conſult the Inſtances of *Dilatations by Introſuſception*; and compare them with the ſame Inſtances after the Dilatations ceaſe, in Bodies where this Ceſſation happens.

Metals recoverable.

4. (2.) The pure and perfect Metals, tho changed and tortured various ways, by Sublimation, Precipitation, Amalgamation, Solution, Calcination, *&c.* are yet generally recoverable by Fire and Fuſion, and convertible into themſelves again: the metalline Nature having no great Agreement with other Bodies. But this Condenſation is the leſs genuine, as it ſeems to be

[i] For the quantity of this kind of Dilatation conſult Mr. *Boyle*'s Philoſophical Works; and Dr. *Halley*'s Computation, in the *Philoſophical Tranſactions*.

[k] As in the Callico-Wrapper, of the *Eaſt-Indies*.

[l] There are many pertinent Inſtances to this purpoſe in Mr. *Boyle*'s Pieces upon *Colours, Effluvia, Phoſphori*, &c.

be nothing more than an emiſſion and excluſion of the Air, interpoſed; or of the Menſtruums in which the Metals were diſſolved; thus giving an Opportunity for the pure Parts of the metallic Body to unite again. And, doubtleſs, the Body poſſeſſes much leſs Space than before; tho it does not ſeem to become denſer in its Subſtance. This *Power of the Keys*, which opens and ſhuts, reigns principally in Metals. And thus foul Metals, as alſo Marcaſites and Ores, are purified; the homogeneous Parts of them being collected together by the Fire; and the Duſt and Droſs thrown off and excluded: for every pure Metal is more denſe and ponderous, than the ſame when impure.

Metals, how condenſed.

5. (3.) It contributes to condenſe Metals, if they be often melted, and quenched in Waters; whereby they become more hard and ſtubborn: but whether their ſpecific Gravity be increaſed by this means, is not hitherto aſcertain'd; and requires a particular Experiment [m]. This Induration, however, is more powerfully effected by frequent Solutions and Reſtorations, than by Fuſions and Extinctions: and it ſhould likewiſe be examined, in what kinds or mixtures of Waters, Metals acquire the greateſt Hardneſs.

Demetallized.

6. (4.) There are certain ways of killing and deſtroying Metals; ſo that when diſſolved and opened, they ſhall be no longer capable of Reduction. And ſomething of this kind appears remarkably in Quickſilver; which, if forcibly ground along with a little Turpentine, Spittle, *&c.* the Quickſilver is killed, and thence acquires an Averſion to recover its priſtine Form [n].

PRECEPT.

The Buſineſs of Demetallization to be farther proſecuted.

7. Diligent Enquiry ſhould be made into the Buſineſs of *mortifying Metals*, or preventing their Reduction, or Reſtitution; for they muſt have a great Antipathy to thoſe things which thus prevent their Parts from coming together. And as all Reſtitution of Metals is a certain kind of Condenſation; a knowledge of the *Privation* will here regard the knowledge of the *Form.*

HISTORY.

No Reciprocal to Dilatation of the Spirit.

8. There is properly, no reciprocal Action oppoſed to the Dilatations proceeding from the native Spirit expanding itſelf; Contraction being a Thing foreign to Spirit, which is never contracted, unleſs it either

[m] It has been tried in Steel, perhaps, and two or three other Metals; but there ought to be a *Table* formed, including the different Gravities of all the Metals, after being heated and quenched, a certain number of Times, in various Liquors; as well Waters of different ſorts, as the Juices of Plants, ſaline Solutions, *&c.* See *M. Reaumur's Treatiſe of converting forged Iron into Steel; and of ſoftening Caſt Iron, ſo as to make Works thereof, equally perfect with thoſe of forged Iron.* Publiſhed at *Paris*, *An.* 1722.

[n] For the buſineſs of Demetallization, ſee *Boyle*, *Becher*, *Homberg*, and *Stahl*: but farther Experiments, and more deciſive, are ſtill wanting on this Head.

ſuffers, is ſuffocated, or collects itſelf, in order to dilate more forcibly. We might, however, here commodiouſly ſubſtitute the proper Action of the groſſer Parts; which is an Action that may, by Accident, be attributed to the native Spirit; when, thro' the eſcape or emiſſion of the Spirit, the Parts are hardened and contracted. Now the Spirit is diſcharged, either by its own proper Agitation, the Sollicitation of the external Air, or the Provocation, or Irritation, of Fire or Heat.

SPECULATION.

The Action of Heat and Age.

9. Fire or Heat, and Time or Age, have one and the ſame Effect, as to the attenuation and diſcharge of the Spirits, and the Actions which follow thereon. But Age, of itſelf, is no more than a Period, or meaſure of Motion; and therefore, when we ſpeak of Age, we mean a Virtue and Operation, compounded of the Agitation of the native Spirit, the ſurrounding Air, and the Rays of the heavenly Bodies. But there is this Difference, that Fire and vehement Heat dilate Bodies ſuddenly, viſibly, and powerfully; but Age, like a very gentle Heat, by degrees, ſlowly, and ſecretly: for groſs Fumes and Vapours are conſpicuous; but not the finer Perſpirations or Effluvia; as is manifeſt in Odours [o]. But the Attenuation and Rarifaction of Bodies by Age, is more ſubtile and exquiſite than that by Fire; for Fire being ſuddain in its Action, cauſes the pneumatical Parts of Bodies to fly off in a hurry; ſometimes alſo, converting the prepared Humidity into pneumatical Matter, and diſcharging it: whence the tangible Parts ſtrongly wedge one another in; and thus, forcibly, arreſt and detain a conſiderable part of the Spirit. But Age does not ſuddenly ſollicit a Diſcharge of what is rendered pneumatical; which therefore, by remaining longer in the Body, gradually and regularly prepares whatever may be digeſted into a fine Subſtance; whilſt but little of the pneumatical Matter already formed, gently, and ſucceſſively ſteals away: ſo as, in a manner, to anticipate, and as it were undermine the Connexion and Cloſeneſs of the tangible Parts. And, therefore, in Diſſolutions by Age, there is found at the laſt, but very little tangible Subſtance remaining fixed or clinging together. For the rotten Powder, left after a long Series of Years, as the Remains of the Depredation, ſuch as is ſometimes found in old Monuments and Sepulchers, appears but like the Carcaſs of the Matter; and is more effete and exhauſted than any Aſhes made by the Fire: for Aſhes have ſtill a Juice that may be drawn from them, and turned into Salt; whereas this kind of Powder contains no Juice, nor Salt at all [p]. But the thing here intended, with regard to the preſent Enquiry, is, that this Spirit, ſo long as it is detained in the Body, reſolves, mollifies, wears, and preys upon the tangible Parts, which, after that is diſcharged, preſently contract and lock themſelves cloſe together.

SECT.

[o] See Mr. *Boyle upon Effluvia.*

[p] See the whole of this Speculation illuſtrated and confirmed in *Boerhaave's Chemiſtry*, particularly under the *Proceſſes upon Vegetables.*

SECT. XIV.

Of CONTRACTIONS *by the Shrinking in of the groſſer* PARTS, *after the Diſcharge of the* SPIRITS.

HISTORY.

1. THE Skins and Membranes of Animals grow dry and wrinkled with old Age. *Contractions inſtanced in Skins.*

2. Such Pears and Apples as have been long kept, grow ſhrivel'd; ſo likewiſe the Kernels of Nuts contract and ſhrink from their Shells. *Fruit.*

3. Old Cheeſes have their Coats wrinkled; Poſts, Wood-Pillars, Pales, *&c.* contract in their Dimenſions by long ſtanding, crack, gape and ſeparate; eſpecially when ſet up green. And the like happens in ſolid Bowls or Balls of Wood. *Wood-work.*

4. The Earth cracks and chops in great Droughts, and becomes full of Chinks on its Surface; and theſe Cracks ſometimes reach ſo deep, that Water iſſues out thereat. *The Earth.*

ADMONITION.

5. Let no one triflingly pretend, that this Contraction, in the caſe of Dryneſs, is no more than a Conſumption of Humidity; for if that were all, and only the Moiſture, converted into Spirit, flew off; Bodies would then retain their former Dimenſions, and barely become cavernous, like Cork or Pumice; and not be locally contracted, and leſſen'd in their Dimenſions [q]. — *Contraction more than Dryneſs.*

HISTORY.

6. Clay is burnt into Brick and Tyle in the Kiln; but if the Heat be violent, as in the middle of the Furnace, ſome part of the Clay is alſo changed in its Nature, and run into Glaſs. *Clay vitrified.*

7. If Wood be ſet on Fire, and the Flame be ſtifled, the Wood turns to a Coal; or a Subſtance more light and ſpongy than Wood [r]. *Wood changed.*

8. Moſt of the Metals when covered in a Crucible, and ſet in the Fire, eſpecially in a reverberatory Furnace, are converted into a friable Subſtance, and calcined. *Metals calcined.*

9. Many foſſil, or metalline, and ſome vegetable Matters, are vitrified by a ſtrong Fire. *Metals vitrified.*

[q] See Dr. *Hook's Micrographia* paſſim; and Dr. *Grew's Anatomy of Plants.*
[r] For the full Proceſs, ſee Mr. *Evelyn's Sylva*; or *Boerhaave's Chemiſtry.*

Tumefiable Bodies changed.

10. All Bodies capable of Tumefaction turn to a coaly Subſtance, and contract their Dimenſions, if too long expoſed to the Fire.

Paper curled by Heat.

11. Paper, Parchment, Skins, *&c.* are not only made to wrinkle in their Parts by the Fire; but alſo to curle, or coil, and wind their whole Subſtance into a Roll.

Tinder.

12. Linen Cloth being ſet on flame, and preſently extinguiſhed, turns into a light Subſtance, which ſcarce takes Flame again, but eaſily ignites; as in the caſe of Tinder.

Unctuous Bodies made empyreumatic.

13. Fat Bodies, as Wax, Butter, Oil, *&c.* become ſcorched, foul, and as it were ſmoky by the Fire.

Eggs.

14. Eggs contract in Bulk by the Fire, and change the Tranſparency of their Whites into an opake Whiteneſs.

Bread.

15. If an Egg be broke into high rectified Spirit of Wine, it turns white and hard; as if it were heated over the Fire. So likewiſe Bread ſteep'd in the ſame Spirit, appears almoſt as if it had been toaſted.

OBSERVATIONS.

The Cauſe and Proceſs of Contraction, upon the Eſcape of the Spirit.

16. (1.) So long as the Spirit is detained in a Body, and excited and dilated by Fire, or Heat; ſo long it keeps itſelf in agitation, endeavours its own Eſcape, ſoftens, ſupples, and fuſes the tangible Parts together: and thus to digeſt, ſubdue, and work together the Parts of Bodies, is the proper Office of the Spirit. But after the Spirit has once found an Exit, and is diſcharged, then the Work of the Parts takes place; and, having been tortured by the Spirit, now combine together, and wedge themſelves cloſe; as well thro' an Appetite of Connexion and mutual Contract, as an Averſion to Motion and Diſturbance. And upon this follows Cloſeneſs, Hardneſs, and a Stubborneſs of the Body.

The End of Contraction by Fire.

17. (2.) There is a Limit and ultimate End of the Proceſs of the Contraction in the Parts of Bodies by Fire; for if the Quantity of Matter be too ſmall to cohere thro' the violent Depredation of the Fire, the Parts deſert each other, are turned to Aſhes, and calcined. And thus much for the *Contractions occaſioned by the Diſcharge of the Spirit of Bodies*; whether it proceed from Age, Fire, or potential Heat.

SECT.

SECT. XV.

Of the Contractions of BODIES *by actual, external Cold.*

TRANSITION.

1. RECIPROCAL to the Action of *Dilatation by actual external Heat*, is the Action of *Contraction by actual external Cold.* And this Condenſation is, of all others, the moſt genuine and proper; and would likewiſe be the moſt powerful, if we had here, upon the Surface of the Earth, any intenſe degree of Cold. But Cold, or a Remiſſion of Heat, (both which we here conſider together) ſimply condenſes ſome things, without altering their Nature; reſtores others, tho imperfectly, that are rarified; and again, perfectly converts and transforms others, by Condenſation, from one Nature to another [f]: each of which we muſt here touch upon, in their turn. *Condenſation by Cold the moſt genuine Condenſation.*

HISTORY.

2. (1.) Air, in a Thermometer, is ſenſible of the Degrees both of Cold and Heat. And, in the Winter, we have ſometimes placed a kind of Cap of Snow, upon the Head of the Glaſs; which has ſo much increaſed the Cold, even in a ſnowy Seaſon, as to raiſe the Water a few Degrees higher, by condenſing the Air [t]. *Inſtances from the Thermometer.*

3. (2.) We above obſerved, that the Air in this Glaſs was dilated a Third; and contracted itſelf as much, upon a remiſſion of the Heat.

PRECEPT.

4. (1.) It deſerves to be tried by particular Experiments, whether Air dilated with Heat, might be fixed in its Expanſion; ſo as not to endeavour its own Reſtoration and Contraction. Take, therefore, a ſtrong Glaſs Tube, heat it violently, then perfectly cloſe up the Orifice, that the Air may not contract; and let the Glaſs ſtand for ſome Days thus cloſed: afterwards plunge it, ſtill ſtopt, into Water; open it under the Water, and obſerve how much Liquor it draws in; or how the Quantity is, in proportion to what it would have attracted, if the Glaſs had been directly put into Water [u]. *To try if rarified Air may be fixed.*

5. (2.) Obſerve likewiſe, by the way, with regard to the *Title of Heat and*

[f] See hereafter, § 36.

[t] See *Novum Organum*, Part II. *Aph.* 13. (38.)

[u] The Experiment might be better tried in the Condenſer, with ſtrongly compreſſed Air. See Mr. *Boyle*'s *Experiments upon the Spring of the Air.*

and Cold, whether Air ſo ſtrongly dilated, and forcibly detained, retains its heat much longer than when the Orifice of the Glaſs is left open.

HISTORY.

Apparent Magnitude of the Stars. 6. (1.) In very clear and cold Nights, during the Winter, the Stars appear larger than in the ſerene Nights of Summer; which proceeds principally from the general Condenſation of the Air at that time, inclining it more to the Nature of Water: for all things appear much larger in Water.

Dews. 7. (2.) Morning Dews are, doubtleſs, Vapours not perfectly diſſipated, and converted into pure Air; but hang imperfectly mixed, till by the cold of the Night, eſpecially in that called the *middle Region of the Air*, they are reflected back, and condenſed into Water.

Rain and Snow. 8. (3.) The Condenſation of Rain, Snow, and Hail, proceeds likewiſe from the Cold of the middle Region; which generally coagulates Vapours higher up than Dews. But here occur two Difficulties, which ſhould be carefully examined. The *firſt* is, whether the Drops of theſe Meteors are congealed and condenſed, in their Fall; or, whether they were firſt collected into larger Maſſes of Water, that hung pendulous in the Air, on account of their Diſtance from the Earth; and were afterwards broke and reduced to Drops, by any Violence: for there are certain Cataracts, or Rains, in the *Weſt-Indies*, which deſcend ſo thick and ſudden, as if they were poured out of Veſſels. The *other* is, whether not only Vapours, which were Water before; but alſo a large part of pure and perfect Air be not coagulated and really changed into Rain, *&c.* by the vehement and intenſe Cold of thoſe Regions[v].

Diſtillation. 9. (4.) In Diſtillations, Moiſture is firſt converted into Vapour; which being now deſerted, thro' its diſtance from the Fire, daſhed againſt the ſides of the diſtilling Veſſel, and ſometimes cool'd by the external Application of cold Water; reſtores itſelf to Liquor again. This ſeems to be a familiar Emblem of the Proceſs of Dew and Rain.

Volatilized Metals. 10. (5.) Some metalline Matters, as particularly Quickſilver, when made volatile, have a ſudden Tendency to reſtore themſelves; and greatly affect to meet with a ſolid Body in their way. And hence they eaſily ſtick, and eaſily fall off again; inſomuch that 'tis ſometimes neceſſary to purſue their Fumes, with the Fire; and tranſmit them from one degree of Heat to another; as it were in an aſcending Scale, or Series of Fires, placed at ſome diſtance from one another, about the Veſſel; leſt the Fume, after aſcending, and

[v] It has not hitherto perhaps been evidently manifeſted by Experiment, that Air is condenſable into Water. But the Experiment of attracting all the Moiſture out of a certain quantity of Air, as it remains in a cloſe Veſſel, by means of the common *Cauſtic*, or other fixed alkaline Salt, deſerves to be carefully proſecuted. For when this Experiment is exactly made; it ſhould ſeem as if almoſt the whole weight of the Air were acquired by the Salt. The Veſſel ſhould here be large; the Scales well made; the Salt perfectly dry, and hot; and all the parts of the Operation performed with care; ſo as to prevent being impoſed upon thro' Overſight.

and being removed from the firſt Fire, ſhould reſtore itſelf ſooner than it ought [w].

11. (6.) Such Things as melt at the Fire, grow denſe upon a Remiſſion of the Heat, and ſolid as before; which is the caſe of Metals, Wax, Fat, *&c.* *Melted Matters.*

12. (7.) A Fleece of Wooll gains weight by lying long upon the Earth; which could not happen, if ſome pneumatical Matter were not condenſed into ſuch as is tangible and ponderous. *Vapours.*

13. (8.) It was an ancient Practice, at Sea, to ſpread and hang out Fleeces of Wooll, by Night, on the ſides of Ships; but ſo as not to touch the Water; and by this means to collect and expreſs a ſweet Water out of them, in the Morning; for the Service of the Voyage.

14. (9.) I have found, upon trial, that four Ounces of Wooll being faſten'd to a Rope, and let down into a Well, fifty ſix Yards deep; but ſo as to come only within twelve Yards of the Water; the Wooll has, in a Night's time, acquired the additional weight of an Ounce and a Dram: and perfect Drops of Water have appeared to ſtick on the out-ſide of the Wooll; ſo that one might, in a manner, have waſhed ones Hands therewith. And this I have ſeveral times tried, with different Increaſes of Weight; but always ſomewhat conſiderable.

15. (10.) Stone, Flint, and Marble; as alſo Rails and other Wood-work, eſpecially if painted, appear manifeſtly moiſt and dewy upon Thaws, or in particular Seaſons, when the Wind is ſoutherly; ſo that they ſeem to ſweat: and may have Drops of Water bruſhed off from them. *Sweating of Houſes.*

16. (11.) In Hoar-froſts there is a Collection of the hoary Matter found froze on the Windows of Houſes; and this to a greater degree on the inſide than on the outſide of the Glaſs. *Froſt on Windows.*

17. (12.) The Breath, which at firſt is but Air drawn in, and moiſten'd by a ſhort Stay in the Cavity of the Lungs, appears turned into a kind of dewy Subſtance, upon Looking-glaſſes, Gems, Sword-blades, and the like poliſh'd Bodies; and afterwards diſſipates, like a fine Cloud. *The Breath.*

18. (13.) Linen is found to contract a Moiſture within Doors; ſo as to reek before the Fire. *Linen.*

19. (14.) All Powders collect a Moiſture in the Cloſets or Places where they ſtand cloſe ſhut up; ſo as to cling together, or form as it were a Maſs. *Powders.*

20. (15.) Some imagine that the Origin of Springs, and ſweet Waters, is owing to the Air ſhut up, coagulated and condenſed in the Cavities of the Earth; but particularly the Cavities of Mountains. *Origin of Springs.*

21. (16.) Miſts are imperfect Condenſations of the Air, conſiſting of a large Proportion of Air, and a ſmall one of aqueous Vapour: and theſe happen in the Winter, about the change of the Weather, from Froſt to Thaw, or from Thaw to Froſt; but in the Summer and the Spring, from the Expanſion of the Dew. *Miſts.*

PRE-

[w] As in the Preparation of Butter of Antimony, *&c.* which ſtick in the Neck of the Retort, and require to be melted down, by applying live Coals on the outſide of the Glaſs.

PRECEPT.

To attempt the Conversion of Air into Water.

22. As the conversion of Air into Water, would be a thing extremely useful; all the Instances having any Tendency this way, should be carefully consider'd [x]: in particular, it should be ascertain'd, whether the Exudations of Marble, and the like Bodies, in rainy Seasons, and southerly Winds, are mere Condensations of the Air, reflected by the hardness and smoothness of the Body, like the Breath on a Looking-glass; or whether they participate at all of the internal and pneumatical Juice of the Stone, *&c.* Trial may be made of this by laying a Cloth upon the Stone; for if the Stone should sweat in this case also, the Exudation must participate of an internal Cause [y].

SPECULATION.

Air convertible into Water.

28. That Air is converted into Water, in the upper Regions, seems certain, from the Conservation of Things; for, doubtless, the Moisture of the Sea and Earth, is converted into pure Air, after it has by Time, Association, and a plenary Rarifaction, totally put off the Nature of Vapour; and therefore, if there was not sometimes a mutual change of Air into Water, as well as of Water into Air, there could not be a sufficient Stock of new Vapours, imperfectly mixed, to supply Rains and Showers, for refreshing and renewing all the Species of Bodies; but there must necessarily follow unsupportable Drought, and Conflagrations, violent Winds, and Tumefactions of the Atmosphere, from a continual Multiplication of Air [z].

HISTORY.

Water in freezing.

24. (1.) Water in freezing does not shrink, but swell in its entire Bulk; and yet it suffers a manifest Condensation of Parts; insomuch that there appear Cracks and Separations within the Body of the Ice: and sometimes, if the Air be permitted to enter, something like Hairs, Strings, and Flowers, appear by degrees. Yet Ice floats on Water: whence 'tis manifest that the Condensation is not total [a].

Wine.

25. (2.) Wine freezes slower than Water; and Spirit of Wine does not freeze at all.

26.

[x] See above § 8.

[y] It now seems generally allow'd that the Moisture in this case proceeds entirely from the Air, and not from the solid Bodies; which only condense the dewy Vapours floating in the Air. But whether there be not also some Conversion of the Air into Water is another Question. See the *History of Winds*, passim. See also the following *Speculation*, and § 8. above.

[z] Compare this with Sir *Isaac Newton*'s Queries to the same purpose, at the end of his *Opticks*. See also the Author's *History of Winds*, passim.

[a] See above, *Sect.* XI. 8.

26. (3.) Mineral acid Spirits, and Quickſilver, have not hitherto been brought to freeze [b]. *Acid Spirits.*

27. (4.) Oils and Fats, freeze, and are thereby condenſed: but not to a degree of impenetrable Hardneſs. *Oils.*

28. (5.) Froſt makes the Earth concrete together, and renders it dry and hard: and in the northern Regions, the Poet obſerves, that Metals are frequently obſerved to crack [c]. And the like we find among ourſelves, in Tables, or other Wood-work; eſpecially where the Parts are glew'd together. And 'tis reported, that even Nails have, by the contraction of Cold, been made to fall from the Walls they were drove in [d]. *Effects of Froſt on Metals.*

29. (6.) Animal Bones become more brittle in froſty Weather; inſomuch that Fractures are, at ſuch times, more common, and difficult of cure. In ſhort, all hard Bodies become more brittle by Cold. *And Bones.*

30. (7.) Waters, or Juices, are manifeſtly condenſed into ſhining or cryſtalline Stones; as appears in ſubterraneous Caverns ſeated among Rocks, where are found Iſicles of various Forms, like the common; only fixed and ſtony; hanging pendulous in their ſlow Fall, or Deſcent from the Roof or Arch; and being congeal'd in the Paſſage: but whether the Matter of them be totally aqueous, or the native Juice of the Stone, with ſome other Mixture, is a Queſtion; eſpecially as Gems and Cryſtals often ſhoot, and riſe upwards out of opened Rocks, and do not fall or hang pendulous downwards: which is a Phænomenon that cannot well be attributed to the Water lodged there [e]. *Petrified Juices.*

31. (8.) Clay is evidently condenſed into Stone; as appears from certain large Stones compoſed of little ones, cemented together by a ſtony Matter, as polite and hard as the Stone itſelf: tho this Condenſation ſeems not to proceed from the ſole Coldneſs of the Earth; but from Aſſimilation; of which more hereafter [f]. *Clay turned to Stone.*

32. (9.) There are certain Waters which condenſe Wood, and other light Bodies, into a ſtony Matter; ſo that the lower part of the Body, which was under the Water, ſhall be Stone; and that above, remain Wood: and hereof I have myſelf ſeen Inſtances. This is a Particular which ſhould be well enquired into; as it may afford great Light in the practical Buſineſs of *Condenſation* [g]. *Wood petrified.*

[b] Oil of Vitriol, if extremely ſtrong, or perfectly dephlegm'd, will appear congealed in an intenſe Cold.

[c] *Æraque diſſiliunt vulgò, veſteſque rigeſcunt.*

[d] See Mr. *Boyle's Hiſtory of Cold.*

[e] See Mr. *Boyle of the Origin and Virtues of Gems*; and the Accounts of the *Caves Goutiers*, given in the *French Memoirs.*

[f] See *Sect.* XVIII.

[g] In particular, let due Enquiry be made, whether it is not owing to the Inſinuation of a petreſcent Matter, into the Pores of the Wood; or whether this be a true and proper Converſion. See the *Articles* ALTERATION, PERCOLATION, PUTREFACTION, and TRANSMUTATION, in the *Sylva Sylvarum.*

PRECEPT.

To try if metallic Waters will not petrify.

33. 'Tis poſſible that *metallic Waters*, by reaſon of the Denſity they contract from the Metals, may have a petrifying Virtue: and of this let trial be made with Straw, thick Leaves, Wood, *&c.* But we conceive ſuch *metallic Waters* ſhould be choſe, as are made by frequently waſhing, or quenching, Metals therein; rather than by Solution; leſt the corroſive Menſtruums, which muſt otherwiſe be employ'd, ſhould hinder the Condenſation [h].

HISTORY.

China *Earth.*

34. (10.) In *China* they have artificial Mines of Porcellane Earth, by burying, at ſome depth under Ground, a certain Maſs of prepared Plaiſter, or Cement; which lying thus buried for about forty Years, is converted into Porcellane. So that theſe Mines are tranſmitted, like an Eſtate, from Father to Son.

Eggs petrified.

35. (11.) I have been well aſſured that an Egg, by long lying at the bottom of a Moat, was found manifeſtly petrified; with the Colours and Diſtinctions of the Shell, White and Yolk, ſtill remaining: only the Shell was here and there broke, and ſhone ſcaly. And I have frequently heard that the White of an Egg has been turned to a ſtony Matter; but neither know the truth of the thing, nor the manner of doing it.

Flame of Spirit of Wine.

36. (12.) Doubtleſs Flame, upon being extinguiſh'd, is converted into ſomething; *viz.* an After-fume; which is again converted into Soot: but the Flame of Spirit of Wine, and the After-expiration of ſuch pure inflammable Subſtances, ſhould be carefully examined; in order to diſcover what Subſtance they are condenſed into, and what kind of After-exhalation they afford: for it does not appear to be any thing fuliginous; as in the caſe of Flame from oily Bodies [i]. And ſo much for the *Contractions of Bodies by actual Cold*, in Air, in Water, in Liquors and in Flame; whether the Contraction were *Simple*, a *Reſtoration*, a *Coagulation*, or a *Converſion*.

SECT.

[h] Let a proper Analyſis be made of the Water of certain known *petrifying Springs*, or *Lakes*; in order to diſcover the Contents of ſuch Waters: from whence artificial petrifying Waters might, perhaps, be made in Imitation of the natural. There are ſome Accounts in the *Philoſophical Tranſactions* of ſuch petrifying Waters, and petrified Subſtances.

[i] See M. *Geoffroy's Memoir upon the Method of diſcovering and aſcertaining the Quality of Brandies and Spirit of Wine*; where he has a particular Method of burning Spirit of Wine; ſo as *apparently* to reſolve a large Proportion thereof into Water. *Memoir. de l'Acad. An.* 1718. See alſo Dr. *Stahl's* three hundred Experiments and Obſervations, printed at *Berlin, An.* 1731.

SECT. XVI.

The Hiſtory of the CONTRACTIONS *of Bodies by* Potential Cold.

TRANSITION.

1. WE next proceed to the Action oppoſite to *Dilatation* by potential Heat; *viz. Contraction by potential Cold.*

2. (1.) As the *medicinal Tables of ſecondary Qualities* are to be conſulted in the Enquiry of *potential Heat*; ſo are they likewiſe in that of *potential Cold*; particularly with regard to *Aſtringency*, *Revulſion*, *Infarction*, *Inſpiſſation*, and *Stupefaction*. *Tables of ſecondary Qualities.*

3. (2.) Opium, Henbane, Hemlock, Nightſhade, Mandrake, and the like Narcoticks, manifeſtly condenſe the Spirits of Animals, turn them back upon themſelves, ſtifle and deprive them of Motion: and whether they have any effect upon dead Bodies, may be tried by ſteeping Fleſh in their Juices; to ſee if any Blackneſs or Gangreen will enſue; or by ſoaking Seeds and Kernels therein; to obſerve whether it will kill them, and prevent their growing; or again, by beſmearing the top of a Thermometer, on the inſide, with their Juices; to diſcover whether this will, in any meaſure, contract the Air [k]. *Stupefactives.*

4. (3.) There are found in the *Weſt-Indies*, even in ſandy Deſarts and very dry Places, large Canes containing, in every Joint, a conſiderable quantity of ſweet Water; to the great Refreſhment of the Traveller. *Water-Canes.*

5. (4.) There is ſaid to be a certain Tree in one of the *Canary Iſlands* [l], that continually diſtils Water; and has a certain dewy Cloud always hanging over it. 'Twere highly worth examining, whether any Vegetable has ſuch a potential Coldneſs, as to condenſe Air into Water. Of this Particular therefore let diligent Enquiry be made [m]. Tho I rather ſuſpect that theſe Trees are no other than the knotted Canes above-mention'd.

6. (5.) Upon the ſmooth Leaves of certain Trees, as thoſe of the Oak, that neither drink in nor preſerve Moiſture, there are found in *England*, ſweet, or as it were, honey-Dews, like Manna; eſpecially in the Month of *May*: but whether this proceeds from any coagulating Virtue in the Leaves, or whether the Leaves only preſerve the Dew, is not certain [n]. *Honey Dews.*

[k] There ſeem to be few Experiments of this kind extant.

[l] It is the Iſland *Ferro*, the moſt weſtern of the *Canaries*.

[m] There are two or three Accounts of this Tree to be found in *Purchas*. One of them runs thus: "In the Iſland *Ferro*, they have no other Water but that which proceeds in the "night from a Tree encompaſſed with a Cloud; whence Water iſſues, ſerving the whole Iſland, "both Men and Cattle: a thing notorious, and known to very many." *Purchas*, Vol. II. Pag. 1673. See alſo, in the ſame Author, the *Obſervations of Sir* Richard Hawkins, *Vol.* II. *pag.* 1367, 1368, and 1369. and the Note at the Bottom.

[n] Or whether it be not the condenſed ſaccharine Juice of the Tree, exuding along with the other aqueous Juices, and dried by the Sun upon the Surface of the Leaf.

Nitre. 7. (6.) There is ſcarce any Subſtance wherein potential Heat is ſo remarkable as in Nitre: for as Spices and other Bodies, tho they have no perceptible Heat to the Touch, yet they have it to the Tongue, and the Palate; ſo Nitre has a perceptible Coldneſs in the Mouth, beyond that of Houſeleek, or any of the coldeſt Plants: whence Nitre ſeems a fit Subject for proving the Virtue and Efficacy of potential Cold.

PRECEPT.

To try whether Nitre will condenſe by its potential Cold. 8. Take, therefore, a ſmall and extremely fine Bladder; blow it up; tie it, and bury it in Nitre for ſome Days; then take it out; and obſerve if the Bladder be any way ſhrunk: if it be, conclude that the Nitre contracted the Air. Let the like Experiment be tried with Quickſilver, by plunging a Bladder therein; the Bladder being tied down, to prevent its riſing, and to avoid the neceſſity of keeping it preſſed.

HISTORY.

Vinegar conſolidating Unguents. 9. If Vinegar be put to Ointment of Roſes, or the like unctuous Body, the Ointment is ſo far from being thinn'd thereby; that on the contrary it becomes more hard and ſolid.

SECT. XVII.

Of the Contractions of Bodies by Flight, and Antiperiſtaſis.

TRANSITION.

Contraction by Antiperiſtaſis oppoſite to Contraction by Conſent. 1. OPPOSITE to the Action of *Dilatation by Conſent, or Embrace*, is that of Contraction by *Flight* and *Antiperiſtaſis*: for as Bodies every way open and relax themſelves to ſuch as are friendly and agreeable, and even run to meet them; ſo when they happen upon ſuch as are unfriendly and odious, they avoid them every way; contract, and ſhrink themſelves up [p].

HISTORY.

Inſtanced in Fire. 2. (1.) The Heat of Fire ſeems to be ſomewhat condenſed, and rendered ſharper by *Antiperiſtaſis*; as in froſty Weather.

2. On

[p] See Sect. IX.

3. On the contrary, in the torrid Zone, Cold ſeems to be condenſed, by *Antiperiſtaſis*; ſo that if any one there ſhelters himſelf under a Tree, from the ſcorching Heat of the Sun, he preſently ſhivers with Cold.

4. (2.) This Operation of *Contraction by Antiperiſtaſis* is not without ſome pretence of Reaſon, attributed to the middle Region of the Air; where Cold collects and unites itſelf, to avoid the ſcattered Rays of the Sun from above; and the reflected Rays from the Earth: whence there are great Condenſations made in that Region of Rain, Snow, Hail, *&c.* *In the middle Region.*

5. (3.) It may, with Juſtice, be doubted whether Opium and other Narcoticks, ſtupefy by potential Cold; or by putting the Spirits to flight: for Opium, by the ſtrength of its ſmell, its bitterneſs, ſudorific Virtue, and other Signs, ſeems to have hot Parts: but as it may emit a Vapour, diſagreeable and odious to the Spirits; it may every way put them to flight; and ſo coagulate and ſtifle them. *Opium.*

SECT. XVIII.

Of the Contractions of Bodies by Aſſimilation, or Converſion into a denſer State.

TRANSITION.

1. OPPOSITE to the Action of Dilatation by *Aſſimilation*, and *Converſion*, into a rarer Body, is the Action of *Contraction* by *Aſſimilation*, and *Converſion*, into a denſer: ſuppoſing it to be done not by Cold, whether actual or potential; but by the power of a more active Body, which multiplies itſelf upon one that is more paſſive. But Aſſimilation to a ſtate of Denſity is leſs frequent, and much leſs powerful, than to a ſtate of Rarity; becauſe denſe Bodies are more ſluggiſh, and unactive, than rare ones, in the buſineſs of aſſimilating. *Contraction by Aſſimilation oppoſite to Dilatation by Aſſimilation.*

HISTORY.

2. (1.) We above obſerved, that Clay intermix'd among little Stones is condenſed into a ſtony Matter. *Clay condenſed to Stone.*

3. (2.) The ſides of the Caſk condenſe a recrementitious part of Wine into Tartar. *Wine to Tartar.*

4. (3.) The Teeth condenſe what adheres to them from chewing the Food and from the moiſture of the Mouth, into Scales; which may be ſcraped off with an Inſtrument, tho they have the hardneſs of the Teeth. *Scales of the Teeth.*

5. (4.) All hard and ſolid Bodies condenſe ſome part of the Liquors adhering to them, on the ſides; but principally at the bottom. *Solids condenſing Fluids.*

6. (5.) Whatever Aliments are converted into a nouriſh'd Matter, more denſe than the Matter of the Aliment, is plainly condenſed in the Aſſimilation; thus the Meat and Drink of Animals is condenſed into Horn, Bone, *&c.* *Aliment.*

SECT.

SECT. XIX.

Of the CONTRACTIONS *of Bodies by external Violence.*

TRANSITION.

The Action oppoſite to Dilatation by external Violence.

1. OPPOSITE to the *Action of Dilatation by external Violence*, whether with or againſt the Appetite of the dilated Body, is the *Action of Contraction by external Violence*; when Bodies are put under a Neceſſity of giving way to the Things that act thereon, and ſo of compreſſing themſelves.

HISTORY.

Inſtanced in Air.

2. (1.) Air eaſily ſuffers ſome degree of Condenſation, by external Violence, or Compreſſion; but will not endure a large one: as appears from ſtormy Winds and Earthquakes.

3. (2.) If a wooden Bucket be inverted, and forced perpendicularly down with the Hand into Water, it will carry Air down with it to the bottom; without admitting Water into it; except a little about the Edges: as will appear by the colour of the Wood, which ſhews the exact Meaſure of the Air's Compreſſure withinſide. This appears ſtill more eminently in that uſeful Invention the *Diving-Bell*, for working under Water; being no more than a large Concave Veſſel of Wood, fill'd with Air, and made to ſtand upon three ponderous metalline Feet, ſomewhat below a Man's height, in order to ſink it. This Veſſel is let down into the Water; and when the Divers want to take Breath, they ſtoop, put their Heads into the Cavity, and there breathe freely. And by this Help occaſionally, they can continue their Work under Water for ſome time; or till the Air, part whereof comes out each time the Head is thruſt in, becomes too little for the purpoſe [q].

The Diving Bell.

The Law of Contraction.

4. (3.) The rarer Bodies are, the eaſier they contract themſelves at firſt; but the more they are compreſs'd beyond their natural Dimenſions, the ſtronger they reſiſt: as is manifeſt in Flame, and condenſed Air cloſe confined.

Flame compreſſed.

5. (4.) Flame, tho but ſimply compreſs'd, (even without a Blaſt, as in Gunpowder,) rages violently; for Example, in Reverberatory Furnaces, where the Flame is check'd, confined, beat back, and diverted in its Courſe.

ADMO-

[q] Or elſe is ſpoiled by having already ſerved for Reſpiration. See the late Improvements of the Diving-Bell, in the *Philoſophical Tranſactions*, N°. 349.

ADMONITION.

6. *Dilatation by Diffuſion* has no reciprocal Action oppos'd to it; becauſe the Bodies diffuſed are not amaſs'd together again, unleſs by melting; as in the Reduction of Metals; which we have mention'd above [r]. *Dilatation by Diffuſion has no Correlative.*

SPECULATION.

7. There is alſo, perhaps, another kind of *Contraction of Bodies*, which is not reciprocal, but poſitive, and by itſelf: for we conceive that in the Solution of Bodies by Liquors; as for Inſtance, Metals, Gums, Sugar, *&c.* the Body is ſomewhat received within the Liquor; and yet the Liquor is not dilated or expanded in Bulk, proportionably to what it takes in. And if ſo, there muſt be a Condenſation; becauſe the ſame ſpace will then contain more Matter. 'Tis certain, in the Solution of Metals, that when once the Menſtruum is fully ſaturated, it will operate or diſſolve no more. And this kind of Condenſation, if there be any ſuch, we may call the *Contraction of Bodies by Saturation.* *Contraction of Bodies by Saturation.*

PRECEPT.

8. Compreſs Aſhes cloſe together; then pour Water upon them; and carefully obſerve how far they ſhrink, after they have taken in the Water; in Compariſon of the Bulk they had before, when mixed only with Air [t]. *Try Aſhes and Water.*

OBSERVATIONS.

9. (1.) The Efficients in the Dilatation of Bodies, diſcovered by the preceding Enquiry, are the nine following; *viz.* (1.) The Introſuſception or Admiſſion of a foreign Body. (2.) A natural or preternatural Expanſion of the native Spirit. (3.) Fire, or external actual Heat; or even a Remiſſion of Cold. (4.) External potential Heat, or auxiliary Spirits. (5.) The Releaſe of the Spirits from the Priſons of the Parts. (6.) Aſſimilation, from the Prevalence of a rarer, and more active Body. (7.) Embrace, or the Attraction of Bodies related. (8.) Separation, or external Violence: and (9.) Diffuſion, or a ſpreading out of the Parts. *The Efficients of Dilatation.*

10. (2.) The *Efficients in the Contraction of Bodies* are eight; *viz.* (1.) Excluſion, or the diſcharge of a Body received. (2.) Shrinking, or Contraction of the Parts, after the Spirit is diſcharged. (3.) External actual Cold, or even a Remiſſion of Heat. (4.) External potential Cold. (5.) Flight and *Antiperiſtaſis.* (6.) Aſſimilation from the prevalence of a denſer and more active *The Efficients of Contraction.*

[r] See Sect. XIII. 5, 6.

[t] See the *Preface to* Dr. Hook's *Poſthumous Works*; and Dr. *Grew* upon *Mixture.*

active Body. (7.) Compreſſion by external Violence: and (8.) Saturation, if there be ſuch a Thing [t].

The Actions without their Reciprocals.

11. (3.) The Actions of Dilatation, (1.) by the native Spirit. (2.) by the releaſe of the Spirits; (3.) by Diffuſion; and, (4.) The Action of Contraction by Conſtriction, are without *Reciprocals*; but ſo are none of the reſt.

The ſpurious Dilatations and Contractions.

12. (4.) The Dilatations by Introſuſception, and by Diffuſion, are ſpurious: ſo are the Contractions by Excluſion; as being not ſubſtantial but local.

The ſimpleſt Expanſion.

13. (5.) Expanſion by Fire, or Heat, without Separation, is the ſimpleſt of all; and performed in a pure pneumatical Body, ſuch as the Air; where nothing exhales, or ſubſides; but a mere Dilatation is made, to a conſiderable Bulk. Whether there be any Thing like this in Flame; that is, whether after the firſt Expanſion of its kindling, which is conſiderable, it expands ſtill farther, after it becomes a formed Flame, is hard to determine; becauſe of its quick and momentary Extinction. But this belongs to the Subject of Flame.

The next ſimple kind.

14. (6.) What approaches next to this Dilatation in point of Simplicity, is the Expanſion that happens in the melting of Metals; or the ſoftening of Iron, Wax, *&c.* ſome time before any Thing becomes volatile and is diſcharged. This Dilatation is ſecret, and tranſacted in the Cavities of the entire Body; without viſibly changing or enlarging its Dimenſions: but as ſoon as any Thing begins to fly off, then the Actions become complicate, or partly rarifactive, and partly contractive; ſo that thoſe contrary Actions of the Fire, vulgarly obſerved to harden one Thing and ſoften another [u], depend upon this; that in one Caſe the Spirit is diſcharged, and in the other detained.

Condenſation by Fire what.

15. (7.) The *Condenſation made by Fire*, tho not ſpurious, but ſubſtantial, is rather a Condenſation of the Parts, than of the Whole: for the groſſer Parts are certainly contracted; yet ſo as to render the entire Body more hollow or porous, and leſs ponderous.

SECT.

[t] See above §. 7.

[u] *Limus ut hic dureſcit, & hæc ut Cera liqueſcit,*
Uno eodemque Igni.

SECT. XX.

Variable CANONS, *or improveable* AXIOMS

1. *THE Total Sum of Matter in the Univerſe, ever remains the ſame; and there is no Paſſage, in Nature, either from Nothing, or to Nothing.*
2. *Of this original Sum, there is more in ſome Bodies, and leſs in others, under the ſame Dimenſions.*
3. *A greater and leſs quantity of Matter afford the true Criterions, if rightly underſtood, of Denſity and Rarity.*
4. *There is a Boundary, or limited Degree of Denſity and Rarity; but not in any Subject known to us.*
5. *There is no* abſolute Vacuum *in Nature.*
6. *Matter folds and wraps itſelf up within the bounds of Denſity and Rarity; and again, relaxes and unbends itſelf, without admitting an abſolute Vacuity.*
7. *The Differences of Denſity and Rarity, in the tangible Bodies known to us, do not greatly exceed the Proportions of thirty two to one.*
8. *The Difference between the rareſt tangible Body, and the denſeſt pneumatical Body, is above a hundred to one.*
9. *Flame is rarer than Air, and Oil than Water.*
10. *Flame is not rarified Air, nor Oil rarified Water; but they are plainly heterogeneous Bodies, without any great Relation between them.*
11. *The Spirits of Vegetables and Animals are Breaths compoſed of an aerial and flamy pneumatical Subſtance; as their Juices are of one that is aqueous and oily.*
12. *All tangible Bodies, here with us, have a pneumatical Subſtance, or Spirit, join'd to, and included in them.*
13. *No Spirits, ſuch as thoſe of Vegetables and Animals, are found looſe, and unconfined amongſt us; but ſhut up, and impriſon'd in tangible Bodies.*
14. *Condenſation and Rarifaction are the proper Effects of Cold and Heat.*
15. *Heat operates upon pneumatical Bodies by ſimple Expanſion.*

16. *Heat has two Operations upon tangible Bodies, and always dilates the pneumatical Parts; but ſometimes contracts, and ſometimes relaxes the groſs ones.*

17. *It obſerves this Rule; when the Spirit of the Body is diſcharged, it contracts, and indurates; but ſoftens and diſſolves, when the Spirit is detain'd.*

18. *Colliquation begins with expanding the pneumatical Parts of the Subject; but other Diſſolutions begin with expanding the groſs Parts, and ſetting free the Operations of thoſe that are pneumatical.*

19. *Next to* Heat *and* Cold, *the moſt powerful Rarifier and Condenſer of Bodies is* Conſent *and* Flight.

20. *Reſtoration from Violence both dilates and condenſes, in a contrary Tendency to the Violence.*

21. *Aſſimilation both dilates and condenſes; as the aſſimilating Body is rarer, or denſer, than the Body aſſimilated.*

22. *The rarer the Body, the greater Expanſion and Contraction it is capable of, from external Violence, to a certain degree.*

23. *If Tenſion, or Preſſure, exceeds its bounds, in a rare Body; ſuch a Body frees itſelf more powerfully, than a denſe one; as being more active.*

24. *The moſt powerful Expanſion, is that of Air and Flame conjointly.*

25. *Dilatation and Contraction are but imperfect, where the Bodies eaſily and readily reſtore themſelves.*

26. Denſity *and* Rarity *have a great affinity with* Gravity *and* Levity.

27. *Man has but little Power in the buſineſs of Condenſation, for want of a potent degree of Cold.*

28. *Age is like a lambent Fire, and acts like Heat; tho in a more exquiſite manner.*

29. *Age brings Bodies either to a ſtate of Putrefaction or Dryneſs*[v].

SECT.

[v] Obſerve that theſe *Canons* or *Axioms* are deduced, as Corollaries, from the preceding *Enquiry*.

SECT. XXI.

DESIDERATA, *and their* APPROXIMATIONS.

DESIDERATUM I.

1. *A Method of condenſing Air into Water.*

APPROXIMATIONS.

The Approximations here are Springs in the Cavities of Mountains; the Exudations of Stone; the Condenſations of the Breath into Dew; the Method of hanging out woolly Matters on the ſides of Ships to collect ſweet Water at Sea; the aqueous Meteors, *&c* [y].

DESIDERATUM II.

2. *A Method of increaſing the Gravity of Metals.*

APPROXIMATIONS.

The Converſion of Iron into Copper; the Increaſe of Lead in Vaults; the Converſion of Quickſilver into Gold; if ſuch Things there are.

DESIDERATUM III.

3. *A Method of petrifying Earths, and other Subſtances, Vegetable or Animal.*

APPROXIMATIONS.

Petrifying Waters; compounded Stones, conſiſting of little ones cruſted together; Cryſtalline Iſicles in Caves; Stones in the Kidneys, Bladder of Urine, and Gall-Bladder; Scales of the Teeth, *&c.*

DESIDERATUM IV.

4. *To diſcover various Uſes of the Motion of Dilatation and Contraction in the Air, by Heat.*

[y] These Particulars are already mentioned in the Body of the *Enquiry*.

APPROXIMATIONS.

The Thermometer; *Hero's Altar* [w]; the Organ made to play by the Sun's Rays; and the Contrivance for imitating the ebbing and flowing of the Sea, and Rivers.

DESIDERATUM V.

5. *A Method of ſuppling the Limbs of Animals, by a proportionate Heat, and the Detention of the Spirit.*

APPROXIMATIONS.

The ſoftening of Iron; the ſoftening of Wax; and the buſineſs of Amalgamations. This regards the Reſtoration of Youth in old Age: for all Humectation, beſides what proceeds from a Detention of the native Spirit, ſeems to be ſpurious, and of little Efficacy [x].

ADMONITION.

Concluſion. We here propoſe but few *Deſiderata*, with their *practical Hints*; becauſe the Subject is ſo general and extenſive, that it rather ſerves to inform the *Judgment*, than direct to *Practice* [y].

End of the Hiſtory of Condenſation and Rarifaction.

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INSTAU-

[w] See Sect. IV. 7.

[x] See the *Hiſtory of Life and Death*, paſſim.

[y] Let it be obſerved that this is no more than a *Delineation, or firſt Draught, of the Hiſtory of Condenſation and Rarifaction*, that requires to be continued, amended, filled up with Inſtances, tranſpoſed and verified, according to the Directions of the ſecond Part of the *Novum Organum*; till the *Canons* become ſtable, and lead, without Error, to Practice; till the *Deſiderata* here mentioned may be readily ſupplied, or ſhewn to be impracticable; and till the Doctrine and Axioms may fully inform, and ſecurely conduct the Mind, in future Enquiries; by way of a *general Opening and Introduction to Phyſics.*

INSTAURATION.

PART V.

BRITISH MUSEUM

INSTALLATION.

PART V.

Philoſophia Prima:

OR, A

TEMPORARY STRUCTURE

OF

PHILOSOPHY,

Raiſed by the

Natural, unaſſiſted Powers of the Underſtanding;

AND OF

Service only till a genuine and pure AXIOMATICAL PHILOSOPHY be procured,

According to the Directions of the

NOVUM ORGANUM.


BRITISH MUSEUM

THE AUTHOR's PREFACE.

WE judge him to have been a beneficent Man, and a prudent Magiſtrate, who when asked if he had given his Citizens the beſt Laws he cou'd, *replied,* the beſt that they wou'd receive [a]. *And, certainly, he who is not content with good Thoughts alone, which are little better than good Dreams; but alſo deſires to obtain his End, and effect his Deſign, muſt not always chuſe the* beſt Things; *but ſometimes prefer the beſt of ſuch as may be received.*

But tho we earneſtly deſire to promote the Good of Mankind in general, as they are all Citizens of the World; yet we think ourſelves not at Liberty to uſe this Legiſlative Power, or make this prudential Choice: and accordingly neither pretend to impoſe Laws upon the Underſtanding, nor upon Things themſelves; but only as faithful Secretaries, receive and write down ſuch Laws *as are publiſhed by the* Voice of Nature. *And therefore, whether ſuch* Laws *ſhall happen to pleaſe or diſpleaſe, and ſo be received, or repeal'd by the* Voice of Opinion, *we are reſolved to execute our Truſt.*

And indeed we conceive Hopes that there are at preſent, and will thro' ſucceeding Ages, ariſe, Men of Eminence, capable of receiving, procuring, and delivering the beſt Things of all; and ſollicitous in cultivating and bringing them to perfection: whence we are determined to continue our Endeavours after theſe better Gifts; opening the Fountains both of Things, *and* Uſes; *and on all ſides ſearching out* Indications *of the right Ways.*

But whilſt we thus ſtrenuouſly purſue the greater Matters, we do not diſregard the leſs; eſpecially as theſe are nearer hand, but thoſe lye farther off: for we duly regard whatever may be of general Uſe;

[a] The Saying of *Solon*, with regard to the *Athenians*.

and promote the common Good. And therefore, tho, in our own Opinion, we lay better Things before Mankind than either the ancient, or thoſe at preſent receiv'd; yet we are far from leſſening theſe latter in the publick Eſteem: but deſire that even theſe ſhou'd be improved, enlarged aud prized as they deſerve. For it is no part of our Intention, to lead all Men totally, or any of them immediately away from the Things at preſent authorized, and believed. But as an Arrow in ſhooting, whirls round its Axis, all the time of its progreſſive Motion; and thus helps itſelf forwards; ſo whilſt we tend to our Mark, we deſire to roll round in the Things now commonly known and received. And thus we candidly and ingenuouſly make uſe of the aſſiſtance of common Reaſon, *and the* vulgar Demonſtrations; *tho we diſallow their ſway, or abſolute Authority: but, with the ſame right as the reſt of Mankind, deliver ſuch Things as we have diſcovered, and approved, by the ordinary Means: for ſuch Things may, doubtleſs, have a great ſhare of Truth and Utility* [b].

By this Procedure, however, we mean not, in the leaſt, to derogate from what we have all along ſaid, of the inſufficiency of the unaſſiſted natural Reaſon, and the Demonſtrations of the Ancients; but only lend out theſe Things to the World for a Time, to accommodate thoſe who, thro' a want of Abilities, or thro' multiplicity of other Affairs, have juſt Excuſe for confining their Contemplations within the old beaten Paths and Provinces of the Sciences, or at leaſt, within the Confines thereof; and again, to ſerve ſuch as, according to our Indications *and* Directions, *ſhall enter into, and purſue, our* true Method of interpreting Nature: *thus ſetting up for them Inns by the way, for their eaſe, ſupport, and refreſhment; whilſt at the ſame time, we in ſome degree promote the Felicity of Mankind; and afford a large ſupply of Matter to ſuch Minds as have a ſomewhat cloſer affinity and connection with Nature. Tho this we no way hope to do, on account of any extraordinary Talent, or any uncommon Reliance we have upon ourſelves.*

On the other hand, if any Perſon of a common Capacity, but of a ripe Judgment, wou'd lay aſide the Idols *of his own Mind, reſolve to begin his Enquiries anew, and with Attention, Diligence and Freedom, converſe among Realities, or the Facts and Experiments of* Natural Hiſtory; *he might thus, doubtleſs, penetrate much farther into Nature, by the ſole proper and genuine Powers of the Mind, and by his own mere natural Thoughts and Apprehenſions, than by reading all*

[b] This Paſſage and the following regard the Author's new *Method of Induction*, and Inveſtigation *of the Forms of Things*, as laid down and exemplified in the Second Part of his *Novum Organum*.

all the Authors that have wrote, or by indulging himſelf in abſtract Contemplations, or by purſuing and repeating the moſt rigorous, and aſſiduous Diſputations: and this tho he were not to uſe any of our Machinery, *or* Contrivances, *to aſſiſt his Underſtanding; nor was acquainted with the true form of* Induction *and* Interpretation [c]. *We, therefore, hope that ſomething of this kind may happen to ourſelves; eſpecially as we have already had ſome Experience in the Buſineſs of* Interpreting Nature; *which may probably correct and change the perverſe Habit and Bent of the Mind* [d].

This, however, muſt not be ſo underſtood, as if we required that Aſſent to our own Doctrines and Opinions, which we refuſe to the Ancients: for we openly profeſs and declare, that we will by no means abide by the Things we ſhall here deliver; whatſoever they may prove: and this purely to reſerve every Thing, as it were entire, for our Secondary, Inductive *and more perfect* Philoſophy [e].

We think proper in the Work itſelf, to deliver our Thoughts looſe and free; without binding them up into Method: becauſe this Form beſt ſuits the young Sciences, *that are but juſt ſprouting a-new from their Roots; and has no Tendency to build up an* Art, *by the cementing of Things together; but leaves, as it ought for the preſent, every Subject unlimited, and open to farther Enquiry* [f].

[c] As deliver'd in the *Novum Organum.*

[d] Which it has to *Idols*, abſtract Speculations, Generals, *&c.* See the *Novum Organum*, pag. 351, *&c.*

[e] Which was to make the *ſixth Part of the Inſtauration.*

[f] The Author appears to have made but little Progreſs in the *fifth Part* of his *Inſtauration*: For it is not certain that any of the few following Pieces, except the *Introduction*, were originally intended for the Place we have here aſſign'd them; at leaſt not till they had been farther improved, and enlarged: whence no true Judgment can be formed of the *Philoſophia Prima* from any Thing left finiſhed, or perfected, in order to it: but the Scope and Deſign thereof muſt be chiefly collected from the preſent Preface, and other Paſſages in the Author's Writings where it happens to be mention'd. See Vol. I. p. 15, and 510. Again, in the *Novum Organum.* Vol. II. Part I. Aph. 116, *&c.* Upon conſidering the whole Deſign, it ſhou'd ſeem that the Author here intended to have laid down the Materials of a more juſt and ſerviceable Philoſophy, than the common; and ſuch as might be uſeful in forming the *Axiomatical Philoſophy*, which he propoſed to begin in the *ſixth* and laſt Part of his general Work, or GRAND INSTAURATION.

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A N

ESSAY

Towards a Scientifical HISTORY of

NATURAL PHILOSOPHY;

FROM THE

Primitive TIMES to the PRESENT.

Deduced by Way of

EXPLANATION upon the *Ancient* FABLE OF CUPID [c].

SECT. I.

The PHILOSOPHY *of ſuch as hold* ONE PRINCIPLE *of all Things.*

1. WHat *the Antients relate of* Cupid, *or* Love, *cannot coincide in the ſame Perſon. And indeed they made two* Cupids, *extremely differing from each other; the firſt being called the eldeſt of the Gods, and the ſecond their youngeſt Son: but our preſent Buſineſs is with the former. The elder* Cupid *is ſaid to be prior to all Things, except* Chaos, *which is* *The Fable of the antient* Cupid.

[c] This is an unfiniſhed, poſthumous Piece, publiſhed by *Gruter* among the *Scripta*; and does not execute half of his original Plan; which was to explain the whole Doctrine of all the ancient Philoſophers, concerning the *firſt Principles of Things*; and ſet that obſcure Affair in a genuine Light; that the grand Work of Experimental Philoſophy might go on, without the Interruption of any fantaſtical Theory, Scepticiſm, or a Diſbelief of the Senſes. And tho the Author has left the Undertaking unfiniſhed, yet there is enough done, to ſet even an ordinary Capacity in the way of executing it; which perhaps requires rather plain natural Senſe, Diligence, and Application, than bright Parts, or a penetrating Genius.

is made coeval with him. He is introduced abſolutely without Parent: but by Mixture with Cœlum, *he is ſaid to have begot the Gods, and every thing elſe. Some, however, relate that he was produced from an Egg, hatched by* Nox. *He has different Attributes aſſigned him; as thoſe of being always a* Child, blind, naked, winged, *and an* Archer. *His principal and peculiar Power is that of uniting Bodies. And the Keys of the Sky, the Sea, and the Earth, are ſaid to be his* [a].

Correſponds to the Philoſophy of Democritus.

2. This *Fable* ſeems, in the narrow compaſs of a Parable, to deliver a philoſophical Account of the *Principles of all Things*, and the Origin of the World, not greatly differing from that of *Democritus*; only the former appears ſomewhat more ſober, exact, and pure. For tho *Democritus* was a very acute and induſtrious Philoſopher; yet his Contemplations run into Extravagance; and did not each other ſort with or ſufficiently ſupport themſelves. And even the Points here couch'd in the *Fable*, tho ſomewhat more correct, are but ſuch as may ſeem to have proceeded from the Underſtanding left to itſelf; and not ſucceſſively, or gradually aſſiſted by Experience [c]. And this we judge to be an Error that prevailed, even in the firſt Ages of the World.

The firſt Exiſtence of Matter.

3. We muſt alſo obſerve, that the Things wrapt up in this *Fable* are but the Concluſions of human Reaſon, and the Dictates of the Senſe, whoſe defective and ceaſing Oracles are now juſtly rejected; ſince better, and more certain Accounts are given us by Revelation. *Chaos*, therefore, which was coeval with *Cupid*, denotes a rude Heap, or Collection, of Matter: but the Matter itſelf, together with its Power, its Nature, and the Principles of Things, are ſhadow'd out in the Perſon of *Cupid*; who is introduced without Parent, that is, without *Cauſe*; for Cauſes are as the Parents of Effects. And it is common, in figurative Speech, to denote the *Cauſe* and *Effect*, by the Words *Parent* and *Offspring*. But for the firſt Matter, and its peculiar Energy and Action; it could have no Cauſe in Nature: (for in aſſigning philoſophical Cauſes we always except God) as nothing exiſted before it. Matter, therefore, had no Efficient, nor any thing better known or cloſer linked to Nature, than itſelf; and conſequently has neither *Genus* nor *Form* [f]. And therefore, whatever this Matter be, together with its Power and Efficacy, it is a poſitive and ſurd Thing; to be taken juſt as we find it: for it cannot be judged of by any previous Notion or pre-

[a] See the ſame *Fable* in the Author's Piece *de Sapientia Veterum*. Vol. I. *pag.* 568.

[c] According to the Method delivered in the ſecond Part of the *Novum Organum*.

[f] Whence the Nature of Matter can never be underſtood by Man; but we are obliged to take it, as our Senſes repreſent it. And it might be for the advantage of Philoſophy to do this, without indulging endleſs Speculations about its Cauſe, the Reality of its Exiſtence, the Poſſibility of its thinking, *&c.* Inſtead whereof the proper Office of Philoſophy is, to diſcover the Laws, the Motions the Modifications, the Transformations and Changes of Matter: but for knowing its *Nature*, or real *Form*, if it had any; this would imply a Poſſibility in Man to *create Matter*, which involves a Contradiction. See *Novum Organum*, Part II. Aph. 4. and the *Hiſtory of Condenſation and Rarifaction*, pag. 505, 569, &c.

pre-conception. And if its *Modus* could be known; this would not be from its Cauſe: as it is, next after God, the Cauſe of Cauſes, and itſelf without a Cauſe. For there is a true and certain Limitation of Cauſes in Nature; and it would be as abſurd and unphiloſophical to require them, when we arrive at the ultimate Powers, and poſitive Laws of Nature; as not to require them in Things of a ſubordinate kind. *Cupid*, therefore, is in the *Fable* wiſely ſuppoſed to be *cauſeleſs*.

The Importance of the Thing.

4. Nor is this an Affair of ſlight Conſequence; but of very great Importance: for Philoſophy has been corrupted from no Quarter more than from this *Enquiry after* Cupid's *Parents*; that is, from Philoſophers not receiving and admitting the *Principles of Things*, as they are found in Nature, for a certain poſitive Point, upon the Atteſtation of Experience; but they have rather derived and deduced them by the Laws of Diſputation, or petty logical Arguments, mathematical Concluſions, vulgar Notions, and the like Excurſions of the Mind, beyond all the Limits of Truth and Nature. A Philoſopher, therefore, ſhould conſtantly bear in Mind, that *Cupid* is Parentleſs; to prevent the Underſtanding from turning aſide to Vanity, and empty Speculation: becauſe the human mind is extremely apt to run into theſe general Notions; ſo as to abuſe both itſelf and Things; and whilſt it endeavours to go forwards, comes back to Matters that lay nearer at hand. For as the Mind, by reaſon of its own Narrowneſs, is moſt accuſtomed to be moved by ſuch Things as occur familiarly to it, and have a power at once to ſtrike and enter the Imagination; it happens that when it extends itſelf to thoſe things which are moſt general in Experience, and yet will not reſt ſatisfied in them; but ſtill endeavours after ſomewhat better known; it falls upon ſuch Things as have the moſt affected, or enſnared it; and abſurdly imagines that theſe are more demonſtrative, and nearer approaching to *Cauſes*, than thoſe Generals it was not content with [g].

Cupid *hatch'd by* Nox.

5. So much for the firſt Exiſtence, and native power of Matter: we come next to the *Modus* of the Thing. And this likewiſe is very obſcure; as the *Fable* elegantly denotes, by making *Cupid* proceed from an Egg hatched by *Nox*. The ſacred Philoſopher pronounces, that *God has made every Thing beautiful in its Seaſon*; *and given the World up to the Diſputes of Men*; *but that Man cannot find out the Works which the Lord has wrought, from the Beginning up to the End.* For the higheſt Law of Exiſtence and Nature, which determines and runs thro' all the Changes of Things; (here expreſſed by *the Works which the Lord has wrought from the Beginning up to the End)* or the Power impoſed by God upon the primitive Particles of Matter; from the Combination whereof proceeds all the Variety of Things; may be ſeen darkly; but can ſcarce be clearly comprehended by the Thoughts of Men. And this Fiction concerning the Egg of *Nox*, is aptly referred to the kind of Demonſtration whereby *Cupid* [h] is brought to Light: for thoſe Things which are concluded by Affirmatives, ſeem to be the *Births of Light*;

[g] Such is the Proceſs of the Mind when it leaves Experience and Senſe, to wander thro' the Maze of general, abſtract Notions. See the *Novum Organum*, pag. 35, *&c.*

[h] *Viz.* The Laws of Matter, and its Motions.

Light; but those concluded by Negatives and Exclusions, are educed and forced, as it were, out of Darkness and Night [i]. And thus *Cupid* is truly an Egg laid by *Nox*; as all the Knowledge we can have concerning the original Law imposed upon Matter, proceeds by Exclusions and Negatives. But all Proof made by Exclusion, is only a kind of Night, with regard to what is included. Whence *Democritus* did well to declare that his *Atoms*, or Seeds, and their Virtue, were like no kind of Thing which could fall under the Senses; and pronounced them perfectly invisible, secret, and concealed by Nature [k]. *Atoms*, therefore, are neither like Sparks of Fire, Drops of Water, Bubbles of Air, Grains of Dust, nor the fine part of Spirit or Æther; nor is their Virtue and Form either Gravity or Levity, Heat or Cold, Density or Rarity, Hardness or Softness, as in the case of larger Bodies; since all these, and the like Properties, are compounded and made up of several. Neither, again, is the natural Motion of Atoms, that of Descent or Ascent, that of Expansion and Contraction, that of Expulsion and Connexion, that of Rotation, or any other Motion of the larger Bodies, simply. Yet in the Bodies of these Atoms are the Elements of all Bodies; and, in their Motion and Virtue, reside the Beginnings of all Motions and Virtues. But here, in the Motion of Atoms compared with the Motion of larger Bodies, the Philosophy of the *Fable* seems different from that of *Democritus*; who does not only disagree with the Fable, but also with himself; so as almost to speak contradictory in what he farther delivers upon this Subject. For he ought to have attributed a Heterogeniety of Motion to his Atoms, no less than a Heterogeniety of Substance and Energy: but he has singled out two Motions from the Motions of the larger Bodies, *viz.* that of the Descent of heavy ones, and the Ascent of light ones, and communicated them to his primitive *Atoms:* whereas the *Fable* throughout maintains as a Heterogeniety, and Exclusion, as well in Substance as in Motion.

The Atoms of Democritus.

The End of Exclusions.

6. The *Fable* farther intimates, that there is some End and Measure of these Exclusions; or that *Nox* does not continue brooding for ever. And certainly it is the Property of God alone, when we enquire into his Nature by means of the Senses, not to need Exclusions for determining Affirmatives [l]. But the case is different in Men; as after due Exclusions and Negations there is somewhat affirmed, determined, and excluded, to them; like an Egg laid after a timely Brooding and Waiting. And not only the Egg is thus laid by *Nox*; but also the Person of *Cupid* is hatched from the Egg: that is, not only a certain Notion of the Thing may be drawn and extracted from

[i] See the *Novum Organum*, Part II. *Sect.* I. *Aph.* 4, &c.

[k] ——— Neque sunt igni simulata, neq; ullæ
Præterea rei, quæ corpora mittere possit
Sensibus, & nostros adjectu tangere tactus.
Again.
Atq; primordia signundis in rebus oportet
Naturam clandestinam cæcamq; adhibere;
Emineat ne quid, quod contra pugnet & obstet.

[l] The *Forms* of Things lying open to him. See *Novum Organum*, Part II. *Aph.* 15.

from Ignorance, but alſo one that is diſtinct and clear [m]. And thus much for that kind of *Demonſtration* concerning the firſt Matter; which is a Demonſtration ſuited to Men, and, in our Judgment, correſponds extremely to the Senſe of the *Fable*.

The Hiſtory of the Democratical Philoſophy.

7. We next proceed to *Cupid* himſelf, or the firſt Matter, together with its Properties; which ſeem enveloped in Darkneſs and Night; to find what Light the *Fable* will afford us herein. But we are well aware that Opinions of this kind enter the Mind with difficulty, and ſeem almoſt incredible, or ſhocking to the Senſe and Thoughts of Men: yet we may plainly perceive, that ſome Attempt has been made in this way, by the *atomical Philoſophy* of *Democritus*; which proving ſubtile, penetrating deep into Nature, and lying remote from common Notions, was looked upon as a childiſh thing by the Vulgar; and being alſo toſs'd about by the Winds of other Philoſophies, which were better ſuited to vulgar Capacities, it is thus in a manner extinguiſhed and loſt. And yet *Democritus* flouriſhed with great Admiration and Applauſe, in his own Times; and by reaſon of his univerſal Knowledge was called *Pentathlus* [n]; and by the general conſent of other Philoſophers, he was allow'd a great *Naturaliſt*; ſo that he obtained the Name of *Magus* [o]. Nor could the violent Conteſts and fierce Oppoſition of *Ariſtotle*, (who, with the *Ottoman* Temper, thought his own Philoſophy would never reign ſecure, till he had murder'd its Competitors; and who tells us plainly, that he was determined to cut off all future Occaſion of doubting;) nor even the Majeſty, and ſolemn Gravity of *Plato*, totally aboliſh this Philoſophy of *Democritus*: but whilſt the Doctrine of *Ariſtotle* and *Plato* were, with great Noiſe and pedantical Pomp, celebrated and reſounded in the Schools; this Philoſophy of *Democritus* was held in great eſteem by the wiſer ſort, who enter'd deep into the ſilent and leſs obvious kind of Contemplations. 'Tis certain, that in the Times of the *Roman* Learning, the Philoſophy of *Democritus* was ſtill in being, and admired; for *Cicero* every where makes mention of him with great Encomiums; and *Juvenal*, not long after, gives him a high Character, after the manner of the *Poets*; who uſually ſpeak the Judgment of their own Times [p]. It was not, therefore, *Ariſtotle* or *Plato*, but *Genſericus* and *Attila*, and the *Barbarians*, that ruined this Philoſophy. And indeed when all human Learning was ſhipwreck'd, thoſe Planks of *Ariſtotelian* and *Platonic* Philoſophy were preſerved, and handed down to us, as a light and tumid Matter; whilſt the more ſolid parts of Knowledge ſunk, and are almoſt buried in

[m] The whole of this Explanation means no more than the *Method of inveſtigating the Forms of Things*, as delivered and exemplified in the ſecond Part of the *Novum Organum*. See *Aph.* 10, 11, 12, 13, *&c.* of that Part.

[n] As if he had underſtood the whole Circle of Arts and Sciences: *Pentathlus* literally ſignifying a Perſon who performs the five Exerciſes of Running, Leaping, Darting, Wreſtling, and throwing the Quoit.

[o] Or *Natural Magician*, in the honourable Senſe of the Word.

[p] —— Cujus prudentia monſtrat
Magnos poſſe viros, & magna exempla daturos,
Vervecum in patria, craſſoque ſub aere, naſci.

oblivion. But the Philoſophy of *Democritus* ſeems to us worthy of being preſerved from Neglect; eſpecially ſince, in numerous Particulars, it agrees with the venerable Doctrine of the earlieſt Ages [q].

The Origin of ſcholaſtic Forms and Ideas, in Matter.

8. In the firſt place therefore, *Cupid* is deſcribed as a Perſon, to whom are attributed *Nakedneſs*, *Infancy*, *Wings*, *Arrows*, and other Things; to which we ſhall ſpeak ſeverally in order [r]. But previous thereto it muſt be obſerved, that the Ancients laid down their *firſt Matter*, which they made the Principle of all Things, as a Matter formed and endowed with Properties and Virtues; and not as an abſtract, potential, and uninformed Maſs. And certainly ſuch a deſpoiled and paſſive Matter, ſeems to be nothing more than a mere Fiction of the human Mind; ariſing from hence, that the Mind gives the greateſt Streſs to the Things it imbibes the ſtrongeſt, and wherewith it is moſt affected: whence it comes to paſs that what Men uſually call *Forms* [s], may ſeem to have a truer Exiſtence than either *Matter* or *Action*; becauſe Matter is a dark, and Action an unſtable Thing: and again, becauſe Matter is not ſo ſtrongly impreſſed upon the Mind, nor Action always inherent: whilſt theſe Phantoms of *Forms* are, on the contrary, thought to be both manifeſt and conſtant; inſomuch that the firſt common Matter is look'd upon but as an Acceſſary or Support; and all Action but as an Emanation, of the *Form*: ſo that the preheminence is abſolutely attributed to *Forms*. And this ſeems to have been the Origin and Foundation of the Kingdom of *Forms* and *Ideas* in Things; *viz.* the ſuperaddition of a certain phantaſtical and imaginary Matter. Theſe phantaſtical Notions have been fed by Superſtition; which is generally the attendant of Error and Extravagance. Abſtract Ideas have alſo been introduced, and their Dignity exalted, with ſo much Confidence and Authority, that the dreaming part of Mankind has, in a manner, prevailed over the waking. But theſe Phantoms now appear to be almoſt vaniſh'd; only certain Writers of our Time, have endeavoured to prop them up, as they were tumbling, and to fix them upon their Baſis again; but doubtleſs the Undertaking is more adventurous than uſeful. And were it not for Prejudice, every Man would ſoon perceive how irrational it is to make abſtract Matter a Principle: for tho they aſſert the actual Exiſtence of ſeparate *Forms*; yet no one aſſerts the ſeparate Exiſtence of Matter; not even of thoſe who make it a Principle. And it ſeems abſurd, prepoſterous, and incongruous to the Enquiry after Principles, to raiſe Eſſences from phantaſtical or notional Things. For the Point is not how we may moſt commodiouſly receive into our Thoughts, or diſtinguiſh the Nature of Eſſences; but what are in reality the primary and

[q] See the *Novum Organum*, Part I. *Aph.* 71, 72, *&c.*

[r] The Piece, we before obſerved, is imperfect, ſo that only the firſt of theſe Attributes of *Cupid* is here ſpoke to; but what is wanting may, in ſome meaſure, be ſupplied from the Author's other Piece, *de Sapientia Veterum*; eſpecially where the Fables of *Cupid*, of *Cœlum*, and of *Pan*, are explained. This philoſophical Comment upon the *Fable of Cupid*, was intended to be ſucceeded with another upon the Fable of *Cœlum*; which would have rendered the Deſign complete.

[s] *Viz.* Abſtract or *Ariſtotelian Forms*; not the *Forms* of the Author, which are determined in Matter. See *Novum Organum*, Part II. *Aph.* 1, 4, 10, 13, 15, *&c.*

and moſt ſimple Eſſences; from which all other Things proceed: for the firſt Eſſence muſt no leſs really exiſt, than thoſe which flow from it; but rather more: ſince this is ſelf-exiſtent; whereas the others only exiſt by its means [v].

9. Indeed, what we find ſaid about abſtract Matter, is not much better than to aſſert that the World, and all Things, are made of *Catagories*, and ſuch logical Notions, as if theſe were Principles: for it is almoſt the ſame to ſay, that the World conſiſts of *Matter*, *Form*, and *Privation*; as that it conſiſts of *Subſtance* and *contrary Qualities*. But nearly all the Ancients, as *Empedocles*, *Anaxagoras*, *Anaximenes*, *Heraclitus* and *Democritus*, tho they differed in other Reſpects about the *firſt Matter*; yet agreed in this, that it was an active *Matter*, of ſome Form, that had a Power of diſpenſing its Form, and a Principle of Motion within itſelf. Nor can any one poſſibly think otherwiſe, who does not plainly deſert Experience. All theſe Philoſophers, therefore, ſubmitted their Minds to Things. *The abſurd Notion of abſtract Matter.*

10. But *Plato* ſubjected the World to Thought; and *Ariſtotle* ſubjected even Thought to Words; the whole Bent and Study of Men then tending to Diſpute, Diſcourſe and Reaſoning; with an utter neglect of all ſevere and rigorous Enquiry after Truth [w]. Whence the Doctrines of this kind are rather to be cenſured in the Lump, than ſeverally confuted; as being the Doctrines of ſuch Men as choſe to talk a great deal, and underſtand but little. And to ſay the Truth, this *abſtract Matter* is entirely a Matter of Diſpute; but not the *Matter of the Univerſe*. And he who wou'd philoſophize in a due and proper manner, muſt diſſect Nature; but not abſtract her, as they are obliged to do, who will not diſſect her. And thus we muſt neceſſarily lay down, (1.) a *firſt Matter*, join'd with (2.) a firſt *Form*, and alſo (3.) with a firſt Principle of Motion, as it is found. For the Abſtraction of Motion has alſo produced infinite phantaſtical Conceits, about Souls, Life, and the like; as if theſe cou'd not be owing to *Matter* and *Form*; but muſt needs depend upon ſeparate Principles of their own. Theſe three Things ſhou'd not be ſeparated, but only diſtinguiſhed; and Matter, whatever it is, muſt be laid down ſo endow'd, prepared and form'd, that all Virtues, Subſtances, Actions, and natural Motions may be the Conſequence and Emanations thereof. And let no one apprehend that Things will, upon this footing, languiſh and become torpid; or that the variety we find in the Univerſe cannot hence be explain'd: for we ſhall ſhew the contrary hereafter [x]. *The true phyſical Notion of a firſt Matter.*

11. And that the *firſt Matter* has ſome *Form*, is indicated by the *Fable* in making *Cupid* a Perſon; ſo that tho the whole Maſs of Matter were at firſt uninform'd and rude; which is repreſented by *Chaos*; yet *Cupid* is form'd and perſonified. And this Account excellently agrees with ſacred Writ; where we read, *that God in the beginning created*, not a confuſed, uninform'd *That firſt Matter has a Form.*

[v] See the true Doctrine and Inveſtigation of Forms explained in the *Novum Organum*. Part II. Sect. I. throughout.

[w] Suppoſe according to the Rule of the *Novum Organum*.

[x] See below, § 14, 15, *&c.*

Maſs of Matter, but *Heaven and Earth*. To this Account, however, is annex'd ſome Deſcription of the ſtate of Things before the ſix days Work; where diſtinct mention is made of Earth and Water; which are Names of Things already formed; yet the Maſs ſtill remain'd uninform'd, in its whole.

Matter naked. 12. But tho the Fable introduces *Cupid* perſonified, it ſtill leaves him naked: and therefore, next after thoſe who wou'd introduce *abſtract Matter*, they err, in the contrary extreme, who introduce it clothed. Somewhat of this Subject we have touched above, in laying down ſuch Demonſtrations as are ſuitable to a *firſt Matter*; the Heterogenieties introduced wherein, we have alſo ſpoke to, in ſome reſpect; but this is the proper place for treating them. We muſt, therefore, here enquire, among ſuch as place the Principles of Things in Matter formed, who they are that have attributed a native, naked Form to Matter; and who have introduced it cover'd and clothed.

The Sects that have ſuperadded Clothing to Matter. 13. There are four different Opinions relating to this Affair. The *firſt* is that of thoſe who aſſert ſome one Thing to be the Principle of all Things; but conſtitute a diverſity of Subſtances in the indeterminate, and diſpenſible Nature of that Principle. The *ſecond* is that of thoſe who make the Principle of Things to be one fix'd and invariable Subſtance; and derive the Diverſities of Bodies from the different Magnitudes, Figures, and Poſitions of this *Principle*. A *third* ſort conſtitute ſeveral Principles of Things; and place the Diverſity of Bodies in the tempering and mixing thereof. And the *fourth* ſort are thoſe who make infinite, or at leaſt, numerous Principles of Things; but ſuppoſe them ſpecificated, and faſhioned: and theſe have no occaſion to invent any Thing elſe for giving a manifold variety; as they have already ſplit and divided Nature from the beginning. But of theſe *four* Sects we judge that only the *ſecond* exhibits *Cupid* native and undreſs'd. For the *firſt* introduces him as it were *veiled*; the *third veſted*; and the *fourth cloak'd*, or wrapt up in a *Mantle*, and almoſt maſked. We ſhall ſpeak a little to each of them, the better to explain the *Fable*.

The Earth not made the Principle of Things. 14. (1.) And *firſt*, we find none of thoſe who conſtitute one Principle of Things, that affirm this Principle to be the *Earth*: for the quiet, languid and unactive Nature thereof, paſſively receiving the Influences of the Heavens, of Heat, and of other Things, has hindered ſuch a Thought from entering into any ones Mind. And yet the earlieſt *Mythology*, or *Wiſdom of the Antients*, places *Terra* next after *Chaos*; and makes it firſt the Parent, and then the Conſort of *Cælum*: from which Conjunction all Things proceeded. But this is not to be underſtood, as if the Antients ever made the *Earth* a Principle of Beings; but only a Principle, or rather the Origin, of a Structure, or Syſtem, of Things. We ſhall therefore refer the Proſecution of this Affair to the following Fable of *Cælum*; under which we propoſe to enquire into the Origin of Things: this latter being an Enquiry poſterior to that of *Principles* [7].

15. But

[7] This *Fable* of *Cælum*, was not, as we above obſerved, explained in the large manner here propoſed; but ſtands, in a contracted View, at the Entrance of his Piece *de Sapientia Veterum*. See Vol. I. pag. 550.

15. But *Thales* makes *Water* the *Principle* of all Things, from obſerving that Matter was chiefly diſpenſed out in Moiſture, and Moiſture diſperſed in Water. And he judged it not improper to lay that down for the *Principle* of Things, in which their Virtues, Powers, Vigour, and eſpecially the Elements of their Generation Increaſe and Repair, are principally found. Thus the Seed of Animals he obſerved is moiſt; and that the Seeds and Kernels of Plants, (ſo long as they continue in a growing ſtate and unexhauſted) are ſoft and tender. Metals likewiſe melt, and appear but as concreted Juices of the Earth; or rather as certain Concretions of the Waters of the Mine [z]. The Earth itſelf is made fruitful, refreſhed and recruited by Rains, and Rivers: and Earth and Mud may ſeem to be only the Fæces and Sediment of Water. Air appears ſtill plainer to be but an Expiration, and Expanſion of Water [a]. And even Fire itſelf cannot be ſuppoſed to exiſt, or be fed and ſupported without Moiſture. For that fat Moiſture, which is the Support and Life of Flame, and Fire, may ſeem but a certain Ripeneſs and thorough Concoction of Water [b]. Again, the Body and Bulk of Water is diffuſed, as a common Matter, throughout this lower World. The Earth is every where watered and encircled by the Ocean. There is an immenſe quantity of ſweet Water in the ſubterraneal Regions; whence Fountains and Rivers, like ſo many Veins in the Body, convey Water over the Surface, and thro' the Entrails of the Globe. In the Regions of the Atmoſphere there are prodigious Collections of Water, and Vapour, that ſeem to ſupply a new Fund thereof; and recruit, refreſh and enliven all the Waters, and the Ocean below. Nay, this Philoſopher went ſo far, that he even ſuppoſed the celeſtial Fires were continually fed with theſe Waters and Vapours; as conceiving they cou'd not ſubſiſt without Aliment, nor derive it from any thing elſe. And for the figure of the particles of Water, he ſaw by Drops, that it was round, or ſpherical, like the Univerſe. He alſo obſerved that Water had an Undulation, and this even in Air and Flame: and laſtly, that it had a due Diſpoſition to Motion, neither too languid nor too quick; and that the Generation of Fiſh and Fowl was extremely numerous [c].

Water made the Principle of Things, in the Philoſophy of Thales.

16. But *Anaximenes* made the *Air* to be the ſole Principle of all Things. For if Bulk is to be regarded in conſtituting the Principles of Things, *Air* ſeems to poſſeſs a very large part of the Univerſe. And if there be no ſeparating *Vacuum*, or if we reject that ſuperſtitious Notion of the heterogeniety betwixt the celeſtial and ſublunary Bodies, the whole ſpace that reaches from the Globe of the Earth to the extremity of the Heavens, and is neither occupied by Stars nor Meteors, may ſeem to be fill'd with an aerial Subſtance.

Air made the firſt Principle by Anaximenes.

[z] This is a Matter of deep Speculation and Enquiry. See *Becher's Phyſica Subterranea.*

[a] See the Author's *Hiſtory of Winds*, paſſim.

[b] Some of Mr. *Boyle's* Experiments appear to confirm, or ſtrengthen, this Suppoſition. See his *Sceptical Chemiſt.* See alſo *Becher* and *Stahl.*

[c] And thus the Point might ſeem, in a manner, diſcovered and ſettled by an Induction of Particulars. But Inductions of Particulars made on one ſide only, are very fallacious; and in no reſpect to be truſted. And yet moſt Philoſophies are of this kind. See the *Novum Organum*, paſſim.

ſtance. But the terreſtrial Globe is no more than a Speck or phyſical Point compar'd with the Heavens, that ſurround it: and in the Æther itſelf, how ſmall a Portion is ſpangled with Stars? Near to the Earth they appear but very few; and higher up, tho their Number indeed be great; yet all the ſpace they poſſeſs ſeems inconſiderable with reſpect to the interſtellar Regions; inſomuch that they may all appear as it were floating in an immenſe Ocean of fine *Air*, or Æther. On the other hand, there is a large quantity of *Air* and *Spirit* lodged in the Water, and Caverns of the Earth; from whence the Waters may be ſaid to receive their Fluidity. Sometimes alſo the *Air* and *Spirit* ſwell or expand themſelves; and may thus eſcape thro' the Pores of the Earth: but Tremblings and Earthquakes are eſteem'd evident ſigns of Wind and *Air* pent up in the Earth's Bowels.

The Diſpoſition of Air for conſtituting a firſt Principle.

17. And if a certain middle Nature be required in Principles, to render them ſuſceptible of ſuch a vaſt variety, this Property ſeems to be found perfect in the Air. For the *Air* appears to be the common Link and Cement of Things; not only becauſe it is every where at hand, and ready to ſucceed and fill up Vacuities; but much more becauſe it ſeems to be of a neutral, indifferent, and indeterminate Nature. For *Air* is that which receives and tranſmits Darkneſs, Light, and all the Tinctures and Shades of Colours and Diminutions of Light; and by its curious undulating Motion diſtinguiſhes Tones, Voices, the Notes of Muſick, and even articulate Sounds; and without Confuſion, diſtinctly conveys all the Variety of Smells, not only thoſe general ones of ſweet and fetid, dull and brisk, *&c.* but alſo the proper and ſpecific Odours of Things, as of each particular Flower, and all the odorous Tribe of Bodies. Again, the *Air* remains neutral and indifferent to thoſe great and powerful Qualities of Heat and Cold, Dryneſs and Moiſture; and in it are at once ſuſpended and convey'd aqueous Vapours, unctuous Exhalations, the Spirits of Salts, the Fumes of Metals, *&c.* all ſeparate and unconfounded. Laſtly, Air is the Fluid wherein the Rays and Influences of the celeſtial Bodies, and the more latent Agreements and Diſagreements of Things, ſecretly reign and act; as if the Atmoſphere were a ſecond Chaos, wherein the Seeds of ſo many Things have their Effects, their Courſes, Trials, Wanderings, and Changes.

18. In ſhort, if we conſider the generating or vivifying Power in Things, which may lead to, and manifeſt their Principle; here again the *Air* will appear excellently qualified: inſomuch that the Words *Air*, *Spirit* and *Soul* are ſometimes confounded, and uſed for the ſame Thing; and this not without Reaſon; as Reſpiration may ſeem to be an inſeparable Attendant upon all perfect ſtates of Life; ſo that, excepting the firſt Rudiments of Life in Eggs, and Embryos, even Fiſh require the uſe of *Air*, and are ſuffocated for want of it, when the Surface of the Water remains long frozen. And Fire itſelf, unleſs animated by the *Air* around it, dies, and may ſeem to be nothing more than *Air* ground together, irritated, and kindled; as on the other hand, Water may ſeem to be *Air* condenſed and ſhrunk within itſelf. Laſtly, the Earth may perpetually exhale *Air*; ſo that Air need not paſs thro' the ſtate of Water in order to obtain its natural Form.

19. *Heraclitus*, with greater Subtilty, but leſs Probability on his ſide, makes *Fire* the Principle of all Things; not looking out for a middle Nature, which is uſually vague and corruptible; but for a high and perfect one, which might prove a certain limit to Corruption and Change. For he ſaw there was a great variety and diſturbance in ſolid and conſiſtent Bodies; which may be organical, or like Machines, that receive innumerable variations even from Figure; as appears in the Bodies of Plants and Animals. And even ſuch of theſe Bodies as are not organical, will, if narrowly look'd into, be found very diſſimilar. For there is a great diſſimilarity between thoſe parts of Animals which are call'd ſimilar; ſuch as the Brain, the cryſtalline Humour, the albugineous Coat of the Eye, Bone, Membrane, Cartilage, Nerve, Vein, Fleſh, Fat, Marrow, Blood, *&c.* And ſo again among the Parts of Vegetables, as the Root, Bark, Stem, Leaf, Flower, Seed, *&c.* Foſſils are certainly not organical; yet appear variouſly mix'd in one and the ſame Species; and exhibit a very copious variety in reſpect of one another. Whence this extenſive Foundation of Diverſity in Bodies, and this large Apparatus, ſeems to be laid in a ſolid and conſiſtent Nature. *Fire made the firſt Principle by* Heraclitus.

20. But in the Bodies of Liquors there ſeems to be no organical Structure. For there appears to be no Animal or Plant, in a Body merely fluid: ſo that this moſt extenſive variety is denied to, and cut off from the Nature of Fluidity. It however remains poſſeſs'd of a conſiderable variety, as is manifeſt from ſo large a diverſity of fuſible Bodies, Juices, diſtill'd Liquors and the like. But the point of Variety is reduced to a much narrower Compaſs in the Maſs of *Air*, and pneumatical Bodies; and obſcured with a promiſcuous ſimilitude of Things. 'Tis certain that the difference of Colours and Taſtes, whereby Liquors are ſometimes diſtinguiſh'd, is here abſolutely wanting; but the impreſſion of Smell, and ſome other Things remain; tho but tranſiently, confuſedly, and in a leſs adheſive manner: ſo that, univerſally, the nearer Bodies approach to the nature of Fire, the more they loſe of their variety. And after they once put on the nature of Fire, in a pure, rectified ſtate; they loſe all that was organical, all their diſtinguiſhing Properties, and all their diſſimilarity. And here Nature ſeems to meet, and unite, as it were, in one pyramidal Vertex; and to have attain'd the ultimate end of its peculiar Action. Whence this Philoſopher call'd *Inflammation*, or *Ignition*, by the name of *Peace*, becauſe it ſettled and quieted Nature, or reduced her to an Uniformity; but Generation he call'd by the name of *War*, becauſe it produced multiplicity and variety. And in order to give ſome Explanation how this was brought about, or how Things ſhou'd from Variety be reduced to Uniformity; and from Uniformity to Variety; like the ebbing and flowing of the Tide; he thought proper to make Fire condenſable and rarifiable: but ſo that its Rarifaction, in aſcending towards a fiery Nature, ſhou'd be the direct and progreſſive action of Nature; but the Condenſation, a kind of Retrogradation, Deſertion, or falling back from Nature: and both theſe he thought happen'd by a certain Fatality at certain Periods, in the general Maſs of Things: ſo that at one time or other, the World itſelf, when its Period was run, ſhou'd be

be ſet on fire, and afterwards renewed; and ſo paſs thro' ſucceſſive Revolutions of Burning and Regeneration, to Perpetuity.

21. And if we attentively look into the remaining hiſtorical Scraps and Fragments of this Philoſopher's Doctrine, he will be found to have made the *Burning* and *Quenching* happen in a different Order. For in the Series of Burning he differed not at all from the common Notions upon that Head; making the Progreſs of the Rarifaction and Expanſion, to be from Earth to Water, from Water to Air, and from Air to Fire: but in the deſcending Scale he has perfectly inverted the Order; and aſſerted, that Fire, by its Extinction produces Earth, or certain Fæces or Aſhes; that theſe Aſhes conceive and collect Moiſture; whence there enſues a Flood of Water; which again ſhall emit and breathe out Air: ſo that the change from Fire to Earth ſhall be ſudden and haſty, not gradual.

The Clothing of Cupid.

22. And theſe, or perhaps ſomewhat better, were the Thoughts of thoſe who conſtituted ſome one Thing the Principle of all others; conſidering Nature ſimply, and not contentiouſly. And they are to be commended for giving *Cupid* but a ſingle Garment; which is the next degree to leaving him naked; eſpecially ſince this Garment; as we before obſerved, is but a kind of a fine Veil, not wove groſs and thick. By the *Clothing of Cupid* we underſtand the attributing of any *Form* to the *firſt Matter*, that may be aſſerted ſubſtantially homogeneal with the *Form* of any one ſecondary Eſſence. And as to the Aſſertions above laid down, from three eminent Philoſophers of Antiquity, with regard to *Water*, *Air*, and *Fire*, it is eaſy to confute them ſeverally; the Foundations they reſt on being not firmly laid: but as there appears no reaſon for diſcuſſing each Point by itſelf, we ſhall only conſider what they have ſaid in the general.

The Errors of the ancient Philoſphers, in laying down their Principles.

23. Firſt therefore, theſe ancient Sages ſeem in their *Enquiry after Principles*, not to have proceeded in any very exact manner; but only from amongſt apparent, obvious and manifeſt Bodies, to have ſought out for the moſt excellent, and to have conſtituted what they thought ſo qualified, the *Principle of all Things*; and this by the way of Eminence, not in the way of preciſe Truth and Reality: for they imagined that ſuch a preheminent Nature was alone worthy to be called what it appears to be; but for other Things they conceived them to be this ſame *Nature* at the Bottom, tho it did not appear: whence they may either ſeem to have ſpoke figuratively, or elſe like Men under ſome Incantation or Prejudice; wherein the ſtronger Impreſſion draws every thing to itſelf. But a true Philoſopher muſt be equal and indifferent to all Particulars; and lay down ſuch *Principles* of Things as ſhall agree even with all the ſmalleſt, leaſt frequent, and moſt deſerted or unregarded Natures; and not only with the greateſt, the moſt numerous and moſt powerful. For altho Men principally admire ſuch Things as occur moſt ſtrong and lively to themſelves; yet the Boſom of Nature is open to all Things.

24. But if they held their *Principles*, not by way of Eminence, but in Simplicity; they certainly ſeem to have fallen upon a very hard Metaphor, or Figure of Speech, which renders their Poſitions plainly equivocal; ſince

ſince what they aſſert cannot be truly ſaid of natural *Fire*; of natural *Air*; or natural *Water*; but muſt be underſtood of certain phantaſtical and notional Things, which retain thoſe Names, without the Signification. They alſo ſeem driven to the like diſtreſs with the Aſſertors of *abſtract Matter*: for as theſe abſolutely introduce a potential and phantaſtical Matter; the former do it likewiſe in part. They alſo, in ſome reſpect, lay down a formed and actual Matter for their *Principle*; but in other reſpects make it only potential: yet they ſeem to gain nothing by thus aſſerting one ſingle *Principle*, more than thoſe who aſſert *abſtract Matter* for their *Principle*; except in this, that they produce an Object for the human Underſtanding, or a Thing whereon the Thoughts may dwell and be more fixed: ſo that the Notion of their *Principle* proves ſomewhat fuller; whereas all thoſe of the reſt are abſtruſe and harſh. The truth is, *Predicaments* had not at that time mounted the Throne; ſo as to conceal the Principle of *abſtract Matter*, under the guard and cuſtody of the *Predicament of Subſtance*. And therefore no Man durſt then attempt to feign, or conjure up, any perfectly phantaſtical Matter; but they delivered their *Principles* according to the Evidence of Senſe; and made them ſome real Being: tho indeed they took a liberty of diſpenſing it out in a phantaſtical manner. For they neither found, nor could invent, by what Appetite or Incitement; by what Method, Proceſs, or Inducement; their Principle ſhould degenerate from itſelf; and again return to its Nature. But as there appears, thro' the Univerſe, ſuch Armies of Contraries, in point of Denſity, Rarity, Heat, Cold, Tranſparency, Opacity, Animation, Inanimation, and numerous other Properties; which oppoſe, deprive and deſtroy each other; to conceive that all theſe ſhould flow from ſome one certain *Fountain of a real material Subſtance*, and yet not ſhew in what manner it happened, may ſeem like giving into a lame and benumbed Theory, and deſerting the Enquiry. For if the Fact itſelf be evident to the Senſes, it muſt be admitted; tho the manner of it remains concealed and unknown. On the other hand, if any probable and adequate Solution ſhould, by the force of Reaſon, be diſcovered, perhaps ſome of the Appearances might be given up: but it can never be required that we ſhould aſſent to thoſe Things, the Exiſtence whereof is neither manifeſt to the Senſes, nor the Explanations of them rendered probable by Reaſon.

24. Again, if there was any one *Principle* of all Things, it ſhould have a certain viſible Mark, or a kind of Superiority and Preheminence in all Things; at leaſt no principiated Body ſhould be found directly oppoſite to its *Principle*. Nay, ſuch a Principle ought to appear in the midſt of Things, that they might commodiouſly participate thereof, and be diffuſed around it: but there is nothing of this kind found in their *Principles*. For the Earth, which is cut off and excluded from the Honour of a Principle, ſeems to receive and cheriſh Natures that are oppoſite to the three above-mentioned Principles. Thus to the noble and ſhining Nature of Fire, it oppoſes the Natures of Reſt and Opacity; to the Rarity and Softneſs of Air, it, in like manner, oppoſes Denſity and Hardneſs; and to the Humidity and flowing Nature of Water, it oppoſes Dryneſs, Aſperity,

Rigidity, and Fixedneſs: nay, the Earth alſo poſſeſſes the middle Place, as if it had thruſt away the reſt.

25. Laſtly, if there was one ſingle *Principle of all Things*, it ought to contribute equally as well to the Generation as to the Diſſolution of them: for it is the Nature of a Principle, that Things ſhould be reſolved into it, as well as that Things ſhould be generated from it. But this is not here the caſe; ſince *Air* and *Fire* ſeem unfit to afford the Matter of Generation; and are rather prepared to receive the Reſolution of Things. *Water*, on the contrary is generative and alimental; but more averſe and unfavourable to Reſolution or Reſtoration: as would plainly appear, if Rain were to ceaſe for any long time. And even Putrefaction itſelf, no way reduces Things to crude and ſimple Water. But the greateſt Error they have committed, is in making their *Principles* periſhable and corruptible: for this they do when they introduce ſuch a Principle as quits and forſakes its Nature in Compoſition [a]. But we ſhall preſently have occaſion to preſs this Argument farther, in ſpeaking to the third kind of Philoſophers; who make ſeveral *Principles* of Things.

SECT. II.

The Philoſophy *of thoſe that maintain more than one* PRINCIPLE of all Things.

1. THE Philoſophers that maintain *ſeveral Principles* of Things, may ſeem to have more ſtrength than the former: they certainly have more Prejudice; and therefore we ſhall conſider their Opinions, not together in the Lump, but each of them ſeparate. We muſt obſerve the Diſtinction already made, betwixt thoſe who aſſert *ſeveral Principles*, and thoſe who make them infinite; the latter will come properly under the *Fable of Cœlum:* at preſent we are concerned only with the former.

The Philoſophy of Parmenides *and* Teleſius.

2. Among the Ancients, *Parmenides* aſſerted *two Principles of Things*; viz. *Fire* and *Earth*, or *Heaven* and *Earth:* for he maintained that the Sun and Stars were pure limpid Fire; not degenerate as it is with us, where it appears like *Vulcan* precipitated head-long from Heaven to Earth, and become lame with the Fall. This Doctrine of *Permenides* has been renewed in our time by *Teleſius*, a Man well verſed in the *Paripatetical* Reaſonings; (if thoſe were of any ſignificance) ſo as to retort the Arguments of that Sect upon themſelves: tho he is entangled with his own Poſitions; and ſeems better at pulling down, than at building up. We have only a very ſlender and ſcanty Hiſtory of the Diſcoveries of *Parmenides:* but the Foundations of an Opinion like his, are plainly laid in the Book that *Plutarch* wrote of the *Primum Frigidum*; which ſeems taken from ſome other ancient Treatiſe, extant at that time, but now loſt: for it contains ſeveral Things of greater

[a] Nam quodcunque ſuis mutatum finibus exit,
Continuo hoc mors eſt illius, quod fuit ante.

greater ſubtilty and ſtrength than are to be found in the original Works of that Author. And this perhaps it was that gave *Teleſius* the Hint, and Courage to lay hold of the Doctrine, and ſtrenuoſly labour it in his own *Eſſays upon the Nature of Things*.

3. The Poſitions of this Sect run thus [b]. They aſſert, (1.) that *Heat* and *Cold* are the *firſt Forms*, or the firſt active Beings, and therefore the primitive Subſtances; and yet that they have an incorporeal Exiſtence, ſupported by a paſſive potential Matter, that may give them a corporeal Bulk, equally ſuſceptible of both Natures, tho itſelf be actionleſs. (2.) That Light is a Pullulation, or ſpringing forth of diſſipated Heat, multiplied and become ſtrong and ſenſible, by collection. (3.) That Rarity and Denſity are but Textures, and as it were the Weavings of Heat and Cold; and that from this weaving or opening by Heat, and contracting by Cold, Bodies have a diſpoſition or indiſpoſition to Motion. (4.) That therefore there are four co-eſſential Natures; *viz.* *Heat*, *Light*, *Rarity*, and *Mobility*; with their Oppoſites, *Cold*, *Darkneſs*, *Denſity*, and *Immobility*. (5.) That the Seats of the former are in the Heavens, the Stars, and particularly in the Sun; but of the latter in the Earth. (6.) That the Heavens having an abſolute and entire Heat, on account of their vaſtly rarified Matter, are moſt violently hot, ſhining, thin and moveable; but that the Earth, on the contrary, from its entire, or undiminiſhed Coldneſs and moſt concentrated Matter, is extremely cold, dark, denſe, perfectly immoveable, and abſolutely averſe to Motion, *&c. &c. &c.* *Its Poſitions.*

4. Such are the Poſitions of *Teleſius*, and perhaps alſo of *Parmenides*, with regard to the *Principles of Things*. And certainly they might appear more true, if there were no ſuch Thing as Man in the World, nor any mechanic Arts to torture, vex and work upon Matter; or if the World was to be ſimply conſidered as a bare Structure, with regard to nothing but itſelf. For this Philoſophy looks more like the Philoſophy of a Shepherd, than of a Naturaliſt; or more like that of a bare Obſerver, than of an Operator; and conſiders the World calmly, and at leiſure; or as in a State of Inactivity: whence it is tolerable, as a mere *Syſtem*; but treats the Buſineſs of *Principles* in a very negligent and unſkilful manner. It alſo commits a great Error in the way of a Syſtem; by making ſuch an one as may ſeem eternal, without ſuppoſing a *Chaos*; or any Changes and Revolutions in the great Structure of Things. For whatever Philoſophy thus faſhions, lays down, and eſtabliſhes a Syſtem, without making it riſe from a chaotic State, ſeems but light, or hypothetical; and indeed diſcovers a narrowneſs of Mind. For whoever philoſophizes according to Senſe, muſt aſſert the Eternity of Matter; and deny it to the World, ſuch as it now appears: which is a Point well obſerved by the Wiſdom of the earlieſt Ages; and, what approaches near to it, the Philoſophy of *Democritus*. And the ſame *The Errors thereof.*

[b] The Author here proceeds to enumerate, in a candid manner, the particular doctrinal Points, maintained by *Teleſius*; which are exceeding numerous; but at preſent generally exploded: we have therefore ſingled out a few of the principal, for a Taſte; tho theſe, no more than the reſt, are ſupportable upon his *Principles*.

is confirmed by the Scripture Account; the difference consisting principally in this, that the Scripture ascribes the existence of Matter to God; whereas the other Accounts wou'd make it self-existent. For there seem to be three Particulars known by *Faith*, with relation to this Affair; *viz.* (1.) That Matter was created out of Nothing; (2.) That a System was produced by the omnipotent Word; or that Matter did not form itself out of *Chaos*, into the Structure we now see; and (3.) That this Structure before the Fall, was the best that the Matter at first created was capable of. But other Philosophies reach'd not so far as to any one of these Points; their Patrons having an abhorrence of a Creation out of nothing; and conceiving the Structure of the Universe produced after many Revolutions, Essays and Endeavours of Matter; whilst they do not concern themselves about ranging it in the best manner; as they make the Structure but perishable and variable. In these Particulars, therefore, it were better to rest upon the Foundations of *Faith*: but more of this in the Fable of *Cælum*, to which it properly belongs [c].

The Principles of Telesius *improveable.*

5. As to the *Principles* of *Telesius*; he might have considerably improved his second, *viz.* that of *Cold*; as he lays it down not for a privation of Heat, but as an independent, active Principle, the rival of *Heat*. And as we desire to favour all the Discoveries that can any way be made in Nature; and wou'd give to every one of them their due weight; he might have proceeded to shew the Action of *Cold* upon Matter, as he has done that of *Heat*, in the following manner. The Seat of Cold is fix'd and immoveable, excellently corresponding to the variable and moveable Structure of Heat; as an Anvil to the Hammer: for if both Principles were variable, and changeable, they wou'd have produced temporary or momentary Bodies. So again, the immense Regions of Heat, which he places in the Heavens, are somewhat balanced by the compact Nature of the terrestrial Globe, and the Bodies about it; as the Thing to be consider'd is not Space; but the quantity of Matter contain'd in Space. Add to this that the Nature, the *Efficacy*, and the degrees of Cold cannot be largely treated of, for want of Opportunities of making Experiments therewith, in order to arrive at certainty. For the coldness of the Earth has no substitute, within the Power of Man, to make Experiments with, corresponding to that of culinary Fire, which is a kind of substitute for the Sun, and manifests the Nature of Heat. As to the cold Exhalations which arise in the Winter from the Surface of the Earth, in the coldest Regions, and diffuse themselves in the Air; they are but a kind of warm Baths, in Comparison of the *primum Frigidum* hid in the Bowels of the Earth; whence the utmost Cold that falls under the Senses, and within the Power of Mankind, may be esteem'd no greater in degree, than that of the Sun in the hottest Countries, compared with the Blast-heat of a Furnace, *&c.* And in this manner might his other Positions be improved.

6. But

[c] See the *Sapientia Veterum*. Fab. 1. Vol. I. p. 550.

6. But the great Fault, both in *Teleſius* and others, who conſtitute *Principles*, is that they derive them from Things which have no Exiſtence; ſo that it were greatly to be wiſh'd Men wou'd once, by a common Conſent, agree to leave off this trifling; and not feign Beings, where no Beings are; or place *Principles* where they find none; and thus avoid embracing a manifeſt Contradiction. For *abſtract Principles*, and *periſhable Principles*, are no *Principles* at all; whilſt there is an unavoidable neceſſity for Men, if they will talk intelligibly, to have recourſe to *Atoms*; which are real, material, figurate, meaſurable Things, capable of Situation, Reſiſtance, Appetite, Motion, Action and Efficacy; remaining for ever unimpair'd and undiminiſh'd, the ſame thro' all the Deſtructions and Changes of natural Bodies. For as there are ſuch varieties of Corruptions in the larger Bodies, there muſt neceſſarily be ſome *central part*, as it were, that remains unchangeable: and this *central part* muſt either be ſomewhat potential, or extremely ſmall. But it can be nothing potential; for the primitive potential Eſſence cannot be like other Things that are potential; which differ in Act from what they are in Power; but it muſt neceſſarily be ſomething abſtracted, as being uncapable of all Action, and yet retaining all Power: whence it muſt conſequently be ſome immutable and extremely ſmall Thing; unleſs any one will maintain that there are no *Principles* at all; but that one Thing is a Principle to another; and that the Law and order of Change is conſtant and eternal; and the Eſſence of Things vague, and mutable. And it wou'd be better, expreſly to aſſert ſomething of this kind, than thro' a deſire of maintaining an eternal Principle, run into a greater Inconvenience, and make that *Principle* phantaſtical. For in the former Caſe there ſeems to be ſome Iſſue; as Things wou'd then change from one to another in a Circle: but on the footing of phantaſtical *Principles*, there is no End; whilſt notional Things, and the Helps of the Mind are held as material Beings.

The general Error in eſtabliſhing Principles.

7. It comes ſtill cloſer to the Point, that there are four *Demonſtrations*, which ſingly confute the Philoſophy of *Teleſius*, as to Principles; and much more when they are united. The *firſt* is, that there are found ſome very powerful and extenſive Actions and Effects in Things, that can in no wiſe be attributed to Heat and Cold. The *ſecond* is, that there are ſome Natures, of which Cold and Heat are the Effects, and Conſequences, not by the excitation of a Heat inherent in them, or the application of an adventitious Heat; but wherein Heat and Cold are lodged and generated from their firſt Exiſtence: whence they fail, on both ſides, of being Principles; as there is ſomething that does not proceed from them; and as they themſelves proceed from ſomething elſe. *Thirdly*, that thoſe Things which have their Origin from Heat and Cold, do yet proceed from them, not as from a proper and intimate Cauſe; but only as from an Effect and Inſtrument. *Fourthly* and Laſtly, That his Conjunction of his four connatural Things, is perfectly diſorderly and confuſed. And to each of theſe we propoſe to ſpeak, in particular.

Four Confutations of the Principles of Teleſius.

8. It may doubtleſs appear to ſome not worth the while to be ſo ſtrenuous in ſubverting the Philoſophy of *Teleſius*, which itſelf is neither famous

The particular Confutation of Teleſius, *why undertaken.*

mous nor received. We anſwer, that we are not above conſidering the more ordinary Matters; but for *Teleſius* himſelf, we have a good Opinion of him, as of a lover of Truth; a Man uſeful in promoting the Sciences; and one whom we acknowledge a principal modern Improver of certain Doctrines. We are not however here concern'd with him as *Teleſius*, but only as he is a Reſtorer of the Philoſophy of *Parmenides*; to which great Reverence is due. But the chief Reaſon of our proſecuting this Subject at large, is to lay, upon the firſt occaſion, ſuch a Foundation as may commodiouſly be transferr'd to the Confutation of the other Sects, which we hereafter propoſe to conſider: ſo as to avoid the Neceſſity of repeating the ſame Things, again and again. For as the Roots and Fibres of different Errors are ſtrangely interwoven and entangled among one another, they may frequently be confuted with one and the ſame Argument; as different as Weeds are cut down with the ſame Scythe [d].

[d] When the Author had enter'd a little into this particular Confutation of the Principles of *Teleſius*, the Diſcourſe breaks off abruptly; ſo that it ſeems more agreable to end it here. It ſhou'd ſeem as if the preſent Piece, had it been finiſhed, was intended to make a Part of the *Tables*, for exhibiting the *ancient* and *modern Philoſophies*, as mention'd Vol. II. pag. 57, 58.

PHY-

PHYSICAL ESSAYS:

Upon different SUBJECTS,

With Regard to the Improvement of

Natural Philoſophy.

I.

Of the CORPUSCULAR PHILOSOPHY.

The Notion of Atoms either true or uſeful.

1. THE Doctrine of *Democritus*, concerning *Atoms*, is either true or uſeful in Demonſtration: for it is not eaſy to conceive in Thought, or to expreſs in Words, the real ſubtilty of Nature, ſuch as we find it in Things, without the Suppoſition of Atoms.

The meaning of the Term, double.

2. This Word has two Significations, not greatly differing from each other: being either taken for the ultimate Diviſion, and the *ſmalleſt Portion of Matter*; or elſe for a *ſolid Particle*, without Vacuity.

Atoms *inviſible.*

3. As to the firſt, theſe two Poſitions may be ſafely laid down; (1.) That *there is a much more ſubtile Diviſion, and Comminution found in Things, than what falls under the Sight*; and (2.) That this *Diviſion cannot be endleſs or continued, in infinitum.* For a diligent Obſerver will find much more ſubtile and fine Parts in continued Bodies, than in ſuch as are ſeparated, and diſcontinued. Thus a little Saffron will tinge a whole Hogſhead of Water; ſo as to render it diſtinguiſhable even by the Sight from pure Water: and this Diffuſion of the Saffron thro' the Water, doubtleſs exceeds the ſubtilty and fineneſs of the moſt exquiſite Powder; as may manifeſtly appear from mixing, in another Hogſhead of Water, a like quantity of the Powder of *Brazil* Wood, Balauſtines, or any other tinging Body,

provided it has not the like tenacity or clammineſs with Saffron; which diſpoſes it to ſpread, open and incorporate with Liquors. It were therefore ridiculous to take *Atoms* for thoſe Corpuſcles, that appear in the Rays of the Sun: ſuch Corpuſcles being but like fine Duſt: whereas, *Democritus* himſelf declares that for *Atoms*, no Man ever ſaw, or can ſee them [e].

The Subtilty of odorous Bodies.

4. This ſubtile Diviſion of Things appears much more ſurprizing in the Caſe of *Odours:* for as a little Saffron may tinge a whole Hogſhead of Water; ſo a very little *Civet* will impregnate the Air of a very large Room, with its Odour, or even two or three Rooms ſucceſſively. And let no Man here imagine that Odours diffuſe themſelves like Light, Heat, or Cold, without any Communication of Subſtance; ſince it is obſervable that Odours will, for a conſiderable time, adnere to Wood, Metal [f], and other ſolid Bodies; and may thence be diſlodged and cleanſed away, by waſhing and rubbing. But in theſe and the like Inſtances, no one of a ſound Judgment will pretend that the Proceſs [g] is infinite; ſince ſuch a kind of Diviſion or Diffuſion is reſtrained to certain Spaces, and certain Limits, or Quantities, of Matter; as evidently appears in the preceding Examples [h].

Hero's *Notion of* Atom *and* Vacuity *explain'd.*

5. As to the *ſecond* Senſe of the word *Atoms*, which ſuppoſes a *Vacuum*, and defines an Atom from the want of Vacuity; *Hero* has beſtow'd laudable Pains about it: denying a *collective* and aſſerting an *interſperſed Vacuity*. For when he ſaw the conſtant Connexion of Bodies; and that no Space cou'd be aſſign'd abſolutely empty of Matter; and, what makes more to the purpoſe; obſerving that heavy and ponderous Bodies wou'd be carried upwards; or even in a manner, depoſite and violate their Natures, rather than ſuffer an abſolute divulſion from the Bodies contiguous to them; he laid it down as certain, that Nature abhorred any great or collective *Vacuum*. On the other hand, when he found that the ſame Matter of a Body wou'd contract, or condenſe itſelf; and again open or dilate; ſo as ſometimes to poſſeſs and fill a larger, and ſometimes a ſmaller ſpace; he cou'd not conceive how this Ingreſs and Egreſs of Bodies in their places happens, without an *interſperſed Vacuity*; that ſhould be leſs when the Body is compreſs'd, and greater when it is relaxed. For this Contraction muſt, of Neceſſity, ariſe, (1.) either becauſe Vacuity is excluded (after the manner juſt now mention'd) in proportion to the Condenſation; or, (2.) becauſe ſome other lighter body, intermixed with the Body condenſed, is ſqueezed out; or, (3.) becauſe there is ſome certain natural Condenſation and Rarifaction of Bodies [i].

6. As to the *ſecond* Caſe, that of ſqueezing out a more rarified Body; it ſeems inconcluſive: for altho Sponges and the like porous Bodies do contract when the Air is ſqueezed out of them; yet it is manifeſt by numerous Experi-

[e] Perhaps Microſcopes cannot be ſo far improved as to render the original component Parts of Matter viſible. Tho this ought to be farther attempted.

[f] As we ſee in perfumed Sword-Blades, *&c.*

[g] *Viz.* Of *Tinging* or *Impregnating.*

[h] *Viz.* Of *Saffron* and *Civet.*

[i] See the Author's Hiſtory of Condenſation and Rarifaction, *paſſim.*

Experiments, that the Air itſelf is capable of great Contraction. Shall we ſuppoſe then that the more ſubtile part of the Air is ſqueezed out; and afterwards another Portion of this part; and ſo on for ever? But it ſtrongly oppoſes this Opinion, that the more rarified any Body is, the greater Contraction it will ſuſtain; whereas the contrary ſhou'd be true, if Contraction happen'd by the Expreſſion of a more rarified part. (2.) As to the *third* way; that the ſame Bodies, no otherwiſe changed, ſhou'd yet have a greater or leſs degree of Rarity or Denſity; it ſeems to be a dogmatical Poſition, depending upon an abſurd unexplain'd Suppoſition, as *Ariſtotle*'s Poſitions generally do. (3.) The *firſt* way, therefore, which ſuppoſes a *Vacuum*, remains as the juſteſt.

Objection, that there ſhou'd be a Vacuum amidſt a plenty of Matter.

7. If any one ſhall here object, that it ſeems ſtrange, and almoſt incredible that there ſhou'd be an interſperſed Vacuity; whereas Matter is every where at hand: let him attentively conſider the *Inſtances* above produced, of Water tinged with Saffron, and Air impregnated with Odours; and he will eaſily perceive there can be no part of the Water aſſign'd, where there is not Saffron; and yet it is plain, by comparing the Saffron, and the Water together, before they are mix'd, that the Body of the Water is immenſly greater, than the Body of the Saffron; and ſo of the Air and the Odour. And if this be the Caſe between different Bodies, much rather may it be allow'd between Body and Vacuity.

The difference betwixt the Speculation of Hero *and* Democritus.

8. But the Speculation of *Hero*, who was only a mechanical Man, yields to the Speculation of the famous Philoſopher *Democritus*, in this, that *Hero* not finding a collective *Vacuum* in the lower Globe of the Earth; thence directly denied its Exiſtence: for this is no Reaſon why there ſhou'd not be a collective *Vacuum* in the Regions of the Æther, where, without doubt, there are great Expanſions and Rarifactions [k].

Admonition.

9. Men ſhou'd here be admoniſh'd, not to confound their Imaginations, and give themſelves up to incertainties, in theſe and the like Enquiries, by reaſon of the ſubtilty of Nature: but to conceive that Generals may as well be ſubmitted to Examination and Calculation as Particulars. Thus it is as eaſy to mention, or think of a thouſand Years, as a thouſand Moments: becauſe thoſe Years conſiſt but of Moments. Nor again, let any one imagine, that ſuch Enquiries as theſe are rather matters of Speculation, than of real Uſe, and conducive to Works: for we find that all the Philoſophers and others, who were vers'd in Experience and Particulars, and have given any true Diſſection of Nature, have always fallen upon theſe Enquiries; tho indeed with no great Succeſs. Nor is there any juſter or ſtronger Reaſon, why the preſent Philoſophy remains barren of Works, than this, that it catches at the *Subtilties of Words*, and vulgar Notions; without purſuing, or determining to enquire into the Subtilty of Nature [l].

[k] See Sir *Iſaac Newton*'s *Principia*, paſſim.

[l] For more upon this whole Subject, conſult the Hiſtory of *Condenſation and Rariſaction*; and the *Sylva Sylvarum*, paſſim. See alſo Mr. *Boyle*'s ſeveral Pieces relating to it.

II.

Of the Similarity and Dissimilarity of ATOMS.

The Numbers of Pythagoras *explained.*

1. THE Doctrines and Discoveries of *Pythagoras* were generally such as seem better fitted for founding a religious Order, than for opening a School in Philosophy: and the Event confirmed it; for his Discipline has prevail'd and flourish'd more in the Heresy of the *Manichees*, and the Superstition of *Mahomet*, than among Philosophers. His Opinion, however, that the World consists of *Numbers*, may be taken in such a Sense, as to enter the Principles of Nature: for there are, and may be, two Opinions concerning Atoms, or the Seeds of Things; the one that of *Democritus* which attributes Dissimilarity, and by Figure, Situation, to *Atoms*: the other, perhaps, that of *Pythagoras*, which wou'd have them all to be perfectly equal and similar. For he who ascribes Similarity to *Atoms*, necessarily places all Things in *Numbers*; but he who allows of other Properties, employs the primitive Natures of separate Atoms, besides the Numbers or Ways of their coming together.

The Changes of Bodies, whence.

2. The practical Question corresponding to this Speculation, and capable of determining the Point, is that which *Democritus* himself proposes; *viz. Whether every Thing may be made out of all Things?* Which he believing impossible, asserted a diversity of Atoms. But the Question to us seems not well put; nor so as to press and determine the Point in the preceding Speculation; if it be understood of the immediate Transmutation of Bodies: but the proper Question is this; *Do not all Things pass in a due Course of Circulations and intermediate Changes?* For no doubt but the Seeds of Things, tho similar, after having thrown themselves into certain Knots, or Combinations, entirely put on the Nature of dissimilar Bodies; till those Knots, or Combinations, come to be dissolved again; insomuch that the Nature and Properties of Compounds may be as great a hindrance to immediate Transmutation, as the Nature and Properties of simple Bodies [l]. But *Democritus*, tho acute in discovering the *Principles of Bodies*, is dissimilar to himself, and unskilful, in examining the *Principles of Motions*; which indeed was the common Defect of all the ancient Philosophers. And yet, possibly, this Enquiry concerning the Primitive State of the Seeds or Atoms of Things, may be of the greatest Utility; afford the supreme Rule of *Action* and *Power*; and justly direct and govern both Hopes and Works [m].

The Action of Separation to be effected.

3. And from hence arises another Enquiry, which tho not so extensively useful as the former; yet comes closer to Things and Works. This Enquiry regards the Business of *Separation* and *Alteration*; so as to discover what

[l] This requires to be well consider'd, and, if possible, to be determined; in order to the working of Changes in Bodies; and producing physical Effects.

[m] For if we cou'd discover the original or primary component Particles of Matter, so as clearly to discern their Arrangements and Compositions, whereon the *Form* or Properties of different Bodies depend; we might be enabled to separate and combine these Atoms so, as, under due Limitations and Restrictions, to produce all the possible Changes in Matter.

what is effected by Separation; and what by other means. For 'tis an Error familiar to the Mind, and has been ſpread, and confirmed by the Philoſophy of the Chemiſts, to attribute thoſe Things to Separation, which are the Effect of ſomething elſe. Thus, for Example, when Water flies off in Vapour, it is eaſy to imagine, that the more ſubtile Part of the Water is here diſcharged, whilſt the groſſer remains behind; as in green Wood, where one part goes off in Flame and Smoke, and another remains behind in Aſhes. And ſomething of this kind might be ſuſpected of Water, in a leſs manifeſt degree: for tho the whole Body of the Water may ſeem to evaporate and be conſumed; yet ſome groſſer Parts, like Aſhes, may remain adhering to the Veſſel. But here the Imagination is liable to be deceived: for it is certain, that the whole Body of the Water may fly off into the Air [n]; or if any thing ſhould ſtick to the Veſſel, this may not proceed from a Separation of the groſſer Parts; but, perhaps, is the ſame Subſtance as that which evaporates; only condenſed by coming in Contact with the Sides of the Veſſel. So we ſee that Quickſilver becomes totally volatile with Heat; and is recoverable again without loſs. So again, in the Oil of Lamps, and the Tallow of Candles, the whole Quantity of the fat Body becomes volatile; without leaving any Aſhes: for Soot is generated after the Flame, not before it; and therefore appears to be the Skeleton or Carcaſs of the Flame; and not the Dregs of the Oil or Tallow.

4. And this may ſerve as an Introduction in *Nature*, to a Confutation of the Notion of *Democritus*, as to a diverſity of Atoms: but for the Introduction in *Opinion*, this is much eaſier, and almoſt ſpontaneous; becauſe the common Philoſophy makes its fictitious Matter indifferent, and ſuſceptible of all Forms. *An Entrance to the Confutation of* Democritus's Atoms.

III.

Of the vulgar Diviſion of MOTION.

1. THE Diviſion of Motion at preſent received in Philoſophy, ſeems but popular, and groundleſs; as diſtinguiſhing the Thing only by its Effects, without regarding the Diſcovery of Cauſes. For Generation, Corruption, Augmentation, Diminution, Alteration, and local Motion, are no more than the Works and Effects of Motions; which arriving at any manifeſt change of Things, ſubject to vulgar notice, they are then very unſcientifically called by thoſe Names. For doubtleſs, the meaning is this; that when a Body, by any kind of Motion has acquired a new Form, or laid aſide an old one, ſo as to complete its Period, or run its courſe; Men agree to call it a Motion of Generation or Corruption: but if the Form *The vulgar Diviſions of Motion ſuperficial.*

[n] Suppoſing the Water perfectly pure, or free from all terreſtrial Matter; tho there is an Experiment produced to ſhew that *Water*, by repeated Diſtillations, is convertible into *Earth*. See Mr. *Boyle* upon the Subject, and *Boerhaave's* Chemiſtry under the *Chapter of Water*.

ſtill remains, and the Body only acquires a new Quality or Dimenſion; this is called *Motion of Increaſe* or *Diminution*. So again, when the Bulk remains the ſame, whilſt the Quality, Actions, and Paſſions are changed; this they call a *Motion of Alteration*: but if the Form, the Bulk, and Quantity, remain the ſame, and nothing is altered but the Place, this they rerm *local Motion*.

Are but the Meaſures of Motion.

2. Whoever conſiders theſe Motions with accuracy and diligence, will find them no other than the Meaſures of Motions; or only Periods, certain Stages, and as it were Taſks of Motions; and not real Differences: as expreſſing indeed the Fact, or what is done; but ſcarce intimating at all how it was brought about. Theſe Expreſſions, therefore, are neceſſary in Teaching; and accommodated to the Methods of Logic; but are extremely empty in reſpect of natural Knowledge. For all theſe Motions will appear compounded, recompounded, and variouſly combined, if we would ſkilfully enter the more ſimple Operations of Nature. For the Principles, the Fountains, the Cauſes, and the Forms of Motions, that is, the Appetites and Paſſions of all kinds of Matter, are required in Philoſophy. So likewiſe are the Impreſſions or Impulſes of Motions, their Checks and Reluctances, their Courſes and Obſtacles, their Alterations and Mixtures, their Revolutions and Concatenations, and in ſhort, the univerſal Proceſs of Motions. Warm Diſputes, probable Reaſonings, vague Contemplations, and plauſible Opinions, are here of little ſervice: but the Buſineſs is by proper Means, and a ſuitable Helping of Nature, to excite, reſtrain, increaſe, remit, multiply, check, and ſtop any Motion, in a Body ſuſceptible thereof; and hence either preſerve, change or transform Bodies, at pleaſure.

Admonition for proſecuting the Enquiry after ſimple Motions.

3. And here ſuch Motions ſhould principally be enquired after, as are ſimple, original, and fundamental; of which the reſt conſiſt: for it is certain, that as the more ſimple Motions are diſcovered, the human Power will be the more enlarged, or the leſs confined to the uſe of determinate Expedients; and the greater Command it will have in producing new Works. And doubtleſs, as that immenſe Variety of Words in all Languages is compoſed of a few ſimple Letters; ſo all the Actions and Powers of Things conſiſt in a few different kinds of original and ſimple Motions [o]. It would therefore be unworthy of Mankind, to have ſo accurately ſifted and diſcovered the minute Differences of their own Voice, and yet remain illiterate in the Voice of Nature; and like the firſt Ages, before the Invention of Letters, underſtand none but compound Sounds and Words; without diſtinguiſhing the ſimple Elements of Speech, or the Letters of the *Alphabet* [p].

IV. *Of*

[o] See the *Novum Organum*, Part II. *Sect.* II. *Aph.* 48.

[p] The Author intended, upon this Footing, to have drawn up an *Alphabet of Nature*, containing all the *ſimple Motions*, *abſtract Natures*, the *cardinal Powers*, *ſummary Motions*, *meaſures of Motions*, &c. but there is only a very imperfect Fragment of it, publiſhed by Dr. *Tenniſon*.

IV.

Of MOTION, *and the moving* Principles of Things.

1. THE operative Philoſopher muſt lay the ſtreſs of his Enquiry upon the Conſideration and Examination of Motion; but the Lovers of Controverſy and Diſpute, may conſider the unactive Principles of Things. We call thoſe *unactive Principles*, which ſhew, whereof things may be made and conſiſt; but not the Means and the Ways whereby they may come together and unite. For 'tis not ſufficient, or of any great ſignificance to Action, and the enlargement of the human Power, to know whereof Things are compoſed; without underſtanding the Ways and Means of producing Changes and Transformations. Thus, does it follow, that he who knows all the ſimple Ingredients of Mithridate, can certainly make that Compound? Or muſt he who has exact Deſcriptions of the Materials and Utenſils employ'd in the making of Glaſs, Sugar, Cloth, *&c.* of neceſſity have the Art of preparing and producing theſe Commodities? And yet the Speculations of Men are principally employ'd in diſcovering and examining theſe dead Principles of Things: juſt as if any one ſhould propoſe and determine to look into the Anatomy of the dead Carcaſs of Nature; without enquiring into her Faculties and Powers, when alive and active. *The dead Principles of Motions chiefly enquired into.*

2. But all the Enquiry made into the *moving Principles of Things* is little more than tranſient: and indeed it is aſtoniſhing to ſee how looſely, and with what Negligence, the greateſt and moſt uſeful Thing in all Nature has been treated and examined. Thus, if we look a little into the Philoſophy on foot, we ſhall find it turning upon ſuch Queſtions as theſe: Can Matter be excited by Privation? Is Matter formed according to Ideas? Do ſimilar Particles come into Aggregates? Are Atoms fortuitouſly tumbled about *in Vacuo?* Is there any Amity and Enmity in Matter? Do the Heavens and the Earth make mutual Impreſſions upon each other? Do the Heavens hold correſpondence by ſymbolizing Qualities? Have the celeſtial Bodies any Influence? Are there any Sympathies and Antipathies in Things? Are there any occult ſpecific Virtues and Properties? Is there any ſuch Thing as Fate or Neceſſity? *&c.* But can all theſe kinds of Generals, which are nothing but Phantoms that play about the Surfaces of Things, be ſerviceable to Mankind; or enlarge our Stock of Knowledge and Power? They may indeed diſtend, and ſwell the Imagination; but can no way contribute to the Production of Works, the changing of Bodies, or the governing of Motions. *And the living ones neglected.*

3. So likewiſe to argue, ſubtilize, and diſtinguiſh betwixt natural and violent Motion, Self-motion, and Motion from without; the Terms and Appellations of Motions, and the like; is not to grapple with Nature; but catching at Shadows. All Matters of this kind, therefore, being dropt, or delivered over to vulgar and ordinary Diſcourſe, thoſe Appetites and Inclinations of Things ſhould be diſcovered, from whence proceeds all that great Variety of Effects and Changes in the Works of Nature and Art: whilſt Men thus endea- *The Method of improving effective Philoſophy.*

endeavour to bring Nature, like *Proteus*, under Conſtraint. And certainly, the kinds of Motion, rightly diſcovered and diſtinguiſhed, are the true Shackles of *Proteus:* for juſt as *Motions*, that is, *Incentives* and *Reſtraints*, are checked and eaſed, ſo is Matter converted and transformed.

V.

Of Violent and Projectile MOTION.

Ariſtotle's Diſtinction of violent from natural Motion.

1. VIolent Motion, as it is called, or the Motion of Projectiles, is one of the moſt common of all Motions; and yet there has been a ſtrange and ſupine Negligence, in not attending to and enquiring about it. This Neglect has proved highly detrimental: for the Motion itſelf is a Thing of infinite Utility; particularly in the Buſineſs of Engines and Machines, Gunnery, and all Mechanicks; whereof it is, in a manner, the Life and Soul. There are many who fancy themſelves to have finiſhed this Enquiry, by pronouncing the Motion we ſpeak of, to be *violent*; and diſtinguiſhing it from *natural Motion*. It is indeed, the peculiar Manner and Conduct of *Ariſtotle*, and his School, to provide Anſwers, and ſhort verbal Determinations; but not to adjuſt and ſettle Things: they ſhew how a Man may diſentangle himſelf in Diſpute, either by affirming or denying; but not what Judgment he ought to form in his own Mind.

A ſecond Opinion of violent Motion.

2. Others, with more Attention, laying hold of this Poſition, that two Bodies cannot be in the ſame Place at once; will have it, that the more forcible one impels, and the weaker gives way; and that this yielding, if the Force applied be ſmall, continues no longer than the firſt Impulſe, in the way of Protruſion: but if greater, that it continues for ſome time after the other Body is removed, till it remits by degrees; as in Throwing. And theſe again, according to another inveterate Cuſtom of the ſame School, catch at the firſt Appearances of Things, without troubling themſelves much with the Proceſs, or Iſſue; as if all Beginnings drew every thing elſe after them: whence they break off their Enquiries with a haſty and untimely Impatience. For to ſay that Bodies give way upon the firſt Stroke, is ſomething; but to the Point, how, after the impelling Body is removed, the Motion ſhould continue, they are ſilent; and have no clear Conception.

A Third.

3. Others again, with greater Diligence and Perſeverance, obſerving that the Force of the Air, as in Winds, *&c.* ſometimes blows down Trees and Buildings; conceive, that the Force attending and carrying Projectiles after the firſt Impulſe, is owing to the Air collected, and ruſhing in behind the moving Body; ſo as to impel it forwards, as a Current drives a Ship. And theſe indeed go thro' with the Matter, and bring the Conſideration to a Concluſion; tho not with the requiſite Truth and Juſtneſs.

The true Notion of the Thing.

4. The Fact ſeems to be this. The principal Motion reſides in the Parts of the Projectile; but this Motion, by reaſon of its Subtilty, being imperceptible to the Sight, Men have careleſly overlook'd it. But whoever conſiders

ſiders the Thing attentively will find, that all hard Bodies are extremely impatient of Preſſure, and have, as it were, a very acute Senſe thereof; inſomuch, that if ever ſo little driven from their natural Figure, they with great Velocity, endeavour to free themſelves; and recover their former State. And in order to this, all the Parts, beginning with the firſt that is ſtruck, thus protrude and thruſt one another, as if by an external Force; whence there enſues a continued and intenſe, tho inviſible Trepidation, Vibration, and Commotion of all the Parts [q]. Thus we ſee Glaſs, Sugar, and the like brittle Things, break not always in the Part ſtruck upon; but in others remote from that where the Blow was given: which evidently demonſtrates this Communication of the Motion of Preſſure to the remoter Parts; which Motion extending every way, and exerting its Force all around, cauſes a Separation in that Part where, from the precedent Diſpoſition of the Body, the Union was leaſt firm. Nor yet does this Motion, tho it runs thro' and diſturbs every part of Body, appear to the Sight, but by the Effect of breaking, or ſeparating the Continuity.

Exemplified in the harder Solids.

5. So again we ſee, if a piece of Iron Wire, a Quill, or the like flexible and elaſtic Body, be bent between the Fingers, and let go again; the Ends preſently ſtart back to their former Situation: the Cauſe of which Motion is, manifeſtly, not in the Parts of the Body ſo bent; but in the Middle, that ſuſtained the Force from which this Motion relieves the Body. And in this Example it plainly appears, that the Cauſe of Motion, above derived from the Impulſe of the Air, is plainly excluded; there being here no Percuſſion to protrude the Air. This is alſo farther manifeſt, from that obvious and common Practice of ſqueezing a Plumb-Stone, whilſt freſh and ſlippery; and thus ſhooting it from between the Fingers: for here alſo Compreſſion performs the office of Percuſſion. But the moſt evident Effect of this Motion is perceived in the perpetual Rotations or Revolutions of Projectiles, flying in the Air: for tho they move continually forwards; yet they do it in Spirals, or by rolling round, and moving forwards at the ſame time. And indeed this ſpiral Motion being ſo rapid, and yet ſo obvious, or as it were familiar to Things, makes us doubt a little, whether it may not depend upon a higher Principle; tho, perhaps, there is no other Cauſe of the Effect than that now offered: for the preſſure of a Body excites a powerful Motion in its ſmalleſt Parts, ſufficient to make it endeavour to releaſe and free itſelf every way; whence a Projectile does not only fly ſtrait forward, but every other way trys to free itſelf; and therefore revolves: for by both theſe means it does ſomething towards its own Relaxation or Releaſe [r].

6. And

[q] If this were the Caſe, would not the projected Body conceive ſome ſmall degree of Heat in the Air? Yet it has not, perhaps, been ſatisfactorily ſhewn, that a Bullet grows at all hot by being diſcharged from a Cannon. But in the Inſtance below, § 5. Iron Wire grows hot by bending. See the *Novum Organum*, Part II. *Aph.* 11, *&c.*

[r] Let this phyſical Conſideration about the Cauſe of the rotatory or progreſſive Motion of Projectiles be compared with Sir *Iſaac Newton*'s *Three Laws of Motion*, &c.

In the ſofter Solids.

6. And tho in Solids this Action may appear ſomewhat ſecret and ſubtile; yet it is very evident and palpable in ſofter Bodies: for as Wax, Lead, *&c.* when ſtruck with the Hammer give way, not only forwards but ſide ways, and all round; in the ſame manner, hard reſiſting Bodies fly forwards, both in a direct Line, and circularly: for there is a correſpondence between the Subſtance of a yielding ſoft Body, and the local yielding in a hard one. And the Paſſion of a hard Body, when it flies and gets away, is clearly underſtood from the change of Figure produced upon a ſoft one.

May be influenced by the Air.

7. We do not, however, deny but the Air may have ſome conſiderable Share in aſſiſting, hindering, directing, and governing the principal Motion thus excited. And this Explanation of *violent* or *mechanical Motion*, which has hitherto lain concealed, is a kind of Fountain to mechanical Works and Practice.

VI.

Of the Correſpondence between Senſible *and* Inſenſible BODIES.

THERE is a great Agreement betwixt the Paſſions of ſenſible and inſenſible Bodies; excepting only that the ſenſible Bodies have a Spirit. Thus the *Pupilla* of the Eye is compared to a Looking-glaſs, or to Water; as it receives and reflects the Images of Light, and viſible Objects, in the ſame manner therewith. So the Organ of Hearing has a Conformity with the Figure of a Cave; which excellently reflects Sound and the Voice. Again, the Sympathies or Attractions of Things inanimate, with their peculiar Dreads and Flights, or Avoidances, correſpond to grateful and diſagreeable Odours in Animals. And for the Buſineſs of Taſte and Touch, it, on the one hand, expreſſes, like an Interpreter, all the Violences; and on the other, all the grateful and friendly Inſinuations, and all the Repreſentations of the Paſſions which can happen in Bodies inanimate. For Compreſſions, Extenſions, Corroſions, Separations, and the like, lie concealed in the Proceſs of lifeleſs Bodies; and are not perceived till after the Effect is manifeſt: but in Animals they are all performed with a Senſation of Pain, according to the different Kinds or Characteriſticks of the Violence; the Spirit here ſuffering along with them all. And from this *Principle* we may know whether any Animal has another Senſation, beſides thoſe obſerved; as alſo how many, and what kind of Senſations there may be in all the Species of Animals. For from the Paſſions of Matter juſtly diſtinguiſhed, will follow the number of Senſations; provided there be ſuitable Organs, accompanied with a Spirit, to obſerve them [f].

VII. *Of*

[f] This is a Speculation of Conſequence, and may perhaps require a little Illuſtration. The Bodies of Animals ſuffer in all reſpects like inſenſible Bodies; that is, with reſpect to their Matter and external Appearance. Thus Plants are wounded and wither, rot and putrefy,

IX.

Of apparent REST, CONSISTENCY, *and* FLUIDITY.

1. THAT certain Bodies ſhould be at reſt, or motionleſs, ſeems reaſonable; if underſtood of their Wholes; but if of their Parts, it may miſlead the Judgment: for there is no ſuch Thing as ſimple and abſolute Reſt, both in the Parts and the Wholes of Bodies: but that which is thought to be Reſt, proceeds either from ſome Impediment, Reſtraint, or equipollency of Motions. Thus, for example, in the Gardener's Watering-pot, which is ſtruck full of Holes at the Bottom; if the Orifice of the Pot be cloſed, the Water will not run out at the bottom Holes. And this apparently proceeds from a retractive Motion, and not from a quieſcent Nature; for the Water ſtill tends as much downwards, as if it were in actual Motion: but as there is no other Body to ſucceed at the Top of the Veſſel, the Water at the Bottom is drawn back by the Water at the Top, and thus forcibly witheld[t]. For if a ſtronger Man ſhould hold down a weaker, ſo that with his utmoſt Strength the weaker ſhould not be able to ſtir; yet the Motion of Re-action is not the leſs, for its not prevailing; or for being bound down by a ſtronger Motion. *Reſt in Bodies, how to be underſtood.*

2. And this Diſtinction of falſe Reſt is proper to be made on many Occaſions; and affords great Light in the Enquiry about the Nature of Solidity and Fluidity. For Solids ſeem to remain quiet, and at reſt, in their Poſition; but Liquids to move about, and be mixed together. Thus a Column or Statue cannot be raiſed of Water; as it may of Wood or Stone: whence Men are apt to imagine, that the upper parts of the Water endeavour, by a natural Motion to flow downwards; but do not allow the ſame as to upper parts of Wood or Stone. Yet the upper parts of Wood have the ſame Tendency downwards, as thoſe of Water; and this Tendency would ſhew itſelf, were it not bound down and reſtrained by another Tendency, that is prevailing; *viz.* by the Appetite of Continuity, or Avoidance of Separation; which is an Appetite reſiding both in Water and Wood: only in Wood 'tis ſtronger, and in Water weaker, than the Motion of Gravity. And that Fluids alſo have this Motion is manifeſt: thus we ſee, in Bubbles of Water, the Fluid throws itſelf into fine Films, in the form of a Hemiſphere, to avoid Separation, or Diſcontinuance: and ſo again, in the Droppings of Spouts, the Water, that it may continue one with the other Water, ſtretches *A falſe Reſt.* *Fluids have an Appetite of Continuity.*

like Animals, living Bodies, *&c.* But Animals having a Spirit and Perception; or a Senſation of Pain or Pleaſure, correſponding to the Action wrought upon them; they know what they feel by a Mark that inanimate Bodies have not: ſo that the Effects wrought upon inanimate Bodies being known, we may infer that Animals have the ſame Effects wrought upon them; and a Set of Senſations agreeable thereto; provided they have Organs to perceive and take notice of them. See *Nov. Organ.* Part II. *Aph.* 27.

[t] This Phænomenon is now explained by the Air's Preſſure being cut off at the Top; but ſtill continuing at the Bottom, ſo as to ſupport the Water.

ſtretches itſelf out into a fine Thread, as long as any Fluid follows from behind; but if Water be wanting to ſupply the Continuation, it then rolls itſelf up into ſpherical Drops, the diameter whereof is much larger than that of the former Thread. In like manner we ſee, that Water difficultly ſuffers a ſubtile Diviſion of its Parts; for it will not by its own natural weight, without Concuſſion, run out at very fine Holes or Cracks. Whence it is certain, that Fluids have an Appetite of Continuity, tho it be weak.

But Solids a ſtronger.

3. But in Solids this Appetite is ſtronger, and over-rules the Motion of Gravity: for if any one imagines that the parts of a Column of Wood, or Stone, have no tendency to fall downwards; but only to ſuſtain themſelves in the ſame State; he will eaſily be undeceived, by obſerving that ſuch Columns, if their Altitude be not proportioned to the width of their Baſes, but run out beyond it, readily over-ſet, thro' their too great weight a-top. And hence all high Structures muſt neceſſarily riſe in a pyramidal Form, or grow narrower towards the Top.

This Appetite whence.

4. But what that Nature is which increaſes and diminiſhes this Appetite of Continuity, is not eaſy to diſcover. It may perhaps be ſuggeſted, that the Parts of Solids are more denſe and compact; and thoſe of Liquids more rare and looſe; or that Liquids contain Air, which is a Principle of Fluidity not contained in Solids: but neither of theſe ſeems agreeable to the Truth. For it is manifeſt that Snow and Wax, which may be cut and wrought, and made to receive Impreſſions, are much rarer than Quickſilver, or melted Lead; as is evident from the diſproportion of their Gravities. But it may be pretended, that perhaps Snow or Wax, tho in their Wholes they are rarer than Quickſilver, yet contain Parts more cloſe and compact; only, being ſpungy Bodies they have many Cavities, and contain Air; whence the total Sum is lighter; as in the caſe of a Pumice, which may perhaps be ſpecifically lighter than Wood; yet if both of them were pulverized, the Powder of the Pumice would be heavier than that of the Powder of the Wood; becauſe the Pumice now no longer retains its Cavities. We allow this to be well objected: but what ſhall be ſaid of melted Snow and melted Wax, where the Cavities are filled up? or, what to gummy Bodies, ſuch as Maſtic, and the like, which have not thoſe viſible Cavities; and yet prove lighter than numerous Liquors?

Not owing to Air.

5. As to the Matter of Air, the Force and Action whereof is ſuppos'd to cauſe Fluidity; this at firſt ſight ſeems probable, and familiar to Mens common Notions; but in reality it is erroneous and ſomewhat hard to conceive; being not only deſtitute of a juſt Reaſon, but almoſt oppoſite to Reaſon: for this pretended Air really induces Conſiſtence, and not Fluidity, as appears evidently in the Inſtance of Snow; which is a Body compounded of Water and Air; each of them ſeparately fluid; yet acquire a Conſiſtence by Mixture. If it be here objected that this may happen from a Condenſation of the aqueous Part by Cold, and not from an interpoſition of the Air; we have an Inſtance to the contrary in Froth, which is a Body like to Snow, and yet in no reſpect condenſed by Cold. If it be ſtill urged

that in Froth the Condenſation proceeds not from Cold, but from Agitation and Percuſſion; we may have recourſe to that Experiment of Children, who by blowing gently thro' a Pipe into ſoapy Water, raiſe a Tower or a Structure of Bubbles, one upon the top of another.

6. The Caſe ſeems to be this; that Bodies reſolve and open themſelves upon the Contact of others ſimilar or agreeable to them; but contract and ſhrink into themſelves upon Contact with diſſimilar Bodies: whence the Appoſition of a foreign Body ſhou'd ſeem the Cauſe of Conſiſtence. Thus we ſee that Oil and Water mix'd together, as in the making of Unguents, put off their Fluidity; and appear in ſome meaſure conſiſtent: on the contrary, Paper moiſten'd with Water reſolves, and depoſites its Conſiſtence, which before was ſtrong, on account of the Air intermix'd in its Pores; but does this leſs when moiſten'd with Oil; becauſe Oil has a leſs agreement with Paper. And the like we find happens in Sugar and Bodies of that kind, which open themſelves to receive Water or Wine: and this not only when ſuch Liquors are poured upon them; but they alſo attract and draw the Liquor up into their Subſtance, when no more than their lower Part is dipped therein [t]. *The probable Cauſe.*

X.

Of the Cauſe of the Motion of EXPLOSION *in Guns and Gunpowder.*

1. THE Phænomenon of Gunpowder, and the Cauſe of Exploſion, tho ſo powerful and noble a Motion, have been hitherto very imperfectly explain'd; and that too in the leaſt conſiderable Part. They pretend that Gunpowder, when converted and rarified into Flame, dilates itſelf, and poſſeſſes a larger Space; from whence follows the Exploſion, or burſting of the obſtructing Body; leſt otherwiſe two Bodies ſhou'd be in one place, or a penetration of Dimenſions enſue, or the Form of the Element be deſtroy'd, or the Situation of the Parts of the reſiſting Body become preternatural. There is ſomething in this; for the Appetite and Paſſion of Matter here mentioned, have ſome ſhare in producing the Effect: but the Error lyes in too haſtily bringing the whole to a neceſſity of the Body's dilating; without diſtinctly conſidering what precedes it in Nature. For tho it be neceſſary that the Body of the Powder, after it is converted into Flame, ſhou'd poſſeſs a greater Space; yet it is not of the ſame Neceſſity, that the Body of the Powder ſhou'd take Flame; and that with ſuch Rapidity: but this depends upon the preceding Conflict, and a train of Motions. For doubtleſs the ſolid and ponderous Body, or Bullet, diſcharged, makes a ſtrong Reſiſtance before it yields; and if this Reſiſtance be great, *The Phænomena of Gunpowder why not well explain'd.*

[t] See Mr. *Boyle* of *Fluidity* and *Firmneſs.*

it must needs prevail; so as that the Flame shall not drive out the Bullet; but the Bullet stifle the Flame. Therefore, if instead of Gunpowder we were to use Sulphur, Camphire or the like Bodies, which also suddenly catch Flame; and because Compactness hinders Inflammability, if these Materials were form'd into Corns of Powder, with a proper Proportion of the most combustible Wood-Coal; yet if Nitre were not employ'd in the Composition, there wou'd follow no such rapid and powerful Motion as in Gunpowder: but the Motion of Inflammation wou'd be check'd, and kept down by the Resistance of the Bullet; and so the Event be frustrated, or no Explosion be made.

A juster Solution.

2. The Case seems to be this. The Motion here enquired after is double and compounded; for besides the Motion of Inflammation, which principally resides in the Sulphur of the Powder; there is another more strong and violent. This chiefly proceeds from the crude and aqueous Spirit of the Nitre; and somewhat again from the Willow-coal. For this Spirit is not only expanded, as Vapours are by Heat; but, what is here the principal Thing, flies away and bursts forth, with the utmost Violence, from the Heat and Inflammation; for which it thus opens and prepares the way. We see some resemblance of this Motion in the crackling of dry Bay or Ivy Leaves, when thrown into the Fire; and still more evidently in Salt, which approaches nearer to the Nature of the Thing under Consideration: we also find somewhat like it when the Tallow of a burning Candle happens to be wet [a]; and frequently in the flatulent Flames of green Wood. But a Capital Instance of this Motion appears in Quicksilver; which is an extremely crude Body, and like a metallic Water; the Force whereof when close confin'd and excited by the Fire, is little inferior to, or, perhaps, stronger than, that of Gunpowder. From this Example, therefore, Men are to be admonish'd, and entreated not suddenly to seize upon any one Thing, in the Enquiry after Causes; and hastily pronounce from it; but to cast about, and fix their Speculations deep and strong.

XI.

Of the quantity of MATTER *in the Universe.*

The Total Sum of Matter always the same.

1. 'TIS evident that all Things change; that nothing is truly lost; and that the total Sum of Matter remains perfectly the same. And as it was the Work of Omnipotence to create Something out of Nothing; the same Omnipotence is required to reduce any Thing back to Nothing. Whether this be effected by a suspension of the conserving Power, or by an Act of Dissolution, is not to the Purpose; 'tis sufficient that it requires the Decree of the Creator. But that Men's Thoughts upon this Position may not be abstracted; or any fictitious Matter introduced; we here advertise, that we

[a] Or more remarkably when cold Water is thrown into boiling Oil, first set on Fire.

we conceive Matter endowed with ſuch a Nature, that it may truly be ſaid one Body contains more, and another leſs thereof, in the ſame Dimenſions: for Example, Lead more than Water, and Air much leſs than Water; and this not in an uncertain and indefinite, but preciſe Proportion; ſo as to be exactly calculated and adjuſted [w]. And therefore, if any one ſhall ſay that Air may be made of Water, and Water of Air; there is no abſurdity in it: but if we ſhou'd ſay that a certain Meaſure of Water may be converted into an equal Meaſure of Air; this is abſurd; and the ſame as to ſay that Something may be reduced to Nothing. And in like manner, to ſay that a certain Meaſure of Air may be converted into the ſame Meaſure of Water; is to ſay, that ſomething may be made out of nothing. And from theſe Poſitions may be derived three *Precepts*, or uſeful Admonitions, directing Men to a more skilful, and thence to a more uſeful Correſpondence with Nature.

2. The firſt is this, that Men ſhou'd frequently call upon Nature, to give in her Account; that is, when they perceive a Body, which was firſt manifeſt to the Senſes, to have flown away and diſappear, they ſhou'd not admit or clear her Account, before they are made ſenſible whither the Body is gone, or what it is received into. This Matter at preſent ſeems treated with the utmoſt Negligence; and Men's Contemplations about it generally end with Sight; ſo that they do not know even where ſuch a common Thing as Flame betakes itſelf: for to imagine it changed into the Body of the Air is abſolutely erroneous [x]. *That Nature be ſummon'd to an Account.*

3. The ſecond Precept is, that Men thus conſidering the unavoidable Neceſſity there is in the Nature of Matter to ſupport itſelf, without being diſſolved, or falling into nothing; they ſhou'd omit no way of torturing, and working upon Matter; if they deſire to diſcover and bring its ultimate Operations and Reſiſtances to Light. This Direction indeed may ſeem not very artificial; but it is ſtill of Uſe. Thus in particular, we may obſerve that the greateſt Impediment Men meet with either in working or experimenting, is this; that they find it ſcarce poſſible to preſerve a certain Maſs of Matter, without Addition or Diminution; whilſt they wou'd urge, preſs, and ſubdue it; but it eludes their ultimate Force by Diviſion or Separation. Now the Separation that may happen here is of two kinds: for either part of the Matter may fly off, as in Decoction; or at leaſt there may be a Separation, as when Cream riſes upon Milk. The Deſign therefore of a deep and intimate Change of Bodies is to vex and torture the Matter of them to the utmoſt, by the proper means; ſo as to prevent, if poſſible, theſe two Separations: for 'tis then that Matter will be really bound and manacled, when all ways of Eſcape are block'd up or cut off [y]. *Matter to be tortured.*

4. The third *Precept* is, that when Men ſee Alterations may be made in Bodies, without any Increaſe or Diminution of their Bulk of Matter, they wou'd firſt purge their Imaginations from this deep-rooted Error, that Alteration *Alterations procurable without Separation.*

[w] See the *Hiſtory of Condenſation and Rarifaction*, pag. 512, &c.
[x] See the *Sylva Sylvarum*, under the Article *Flame*.
[y] To this purpoſe ſee the Hiſtory of *Condenſation and Rarifaction*, pag. 540.

Alteration proceeds only from a Separation of Parts; and ſecondly, with Skill and Diligence, begin to diſtinguiſh betwixt Alterations; and learn when they are owing to a Separation, when only to a diſorder or different ſituation of Parts, without any Separation; and when to both. Thus for Example, when an auſtere and unripe Pear is ſqueezed, bruiſed, rolled, or ſtrongly wrought with the Hand, and thence acquires a ſweetneſs; or when Amber or Gums are reduced to fine Powder, and loſe their Colour and Beauty; it is not conceivable that any conſiderable Portion of their Subſtance ſhou'd be waſted; but only the Parts of the Bodies brought into a new Arrangement or Order.

That Spirits and ſubtile Bodies may be confined.

5. There is alſo another Error to be extirpated, of ſuch Force, that, if it prevails, ſome of the Particulars here intimated may be held as deſperate: for it is a common Opinion that the Spirits of Things, when rais'd or rarified by Heat to a certain high degree of Tenuity, will eſcape thro' the ſmall Pores of the moſt ſolid Veſſel, whether of Silver, Glaſs, *&c.* which is not true: for neither Air nor Spirit, tho rarified by Heat, nor even Flame itſelf readily becomes ſo fine, as to paſs or make its way thro' ſuch Pores. Nor indeed wou'd Air ſuſtain to be cloſe confined and compreſſed, if it cou'd any way perſpire and get out at the Pores of the containing Veſſel. Men, therefore, need not be ſo apprehenſive that the Spirits of Bodies ſhou'd eaſily eſcape them; eſpecially ſince the *Spirits* they frequently require, which are thoſe of Odours, Taſtes and the like, may certainly be confined.

XII.

Of the Ebbing and Flowing of the SEA.

Five Motions of the Sea.

1. THE Cauſes of the *Ebbing and Flowing of the Sea* were touch'd upon by the Antients; and afterwards dropt: but have again been renew'd by the Moderns; tho with ſuch a variety of Opinions, as ſeems rather to confound the Imagination, than diſcuſs the Point. *Vulgar Conjecture* attributes this Phænomenon to the Moon; by reaſon of ſome Correſpondence between the Tides and the Moon's Motion: but, if we carefully examine the Matter, there will appear ſome Traces of Truth, capable of leading us to greater Certainty. To prevent Confuſion in this Enquiry, the Motions of the Sea ſhou'd be firſt diſtinguiſh'd; which, tho conſiderably multiplied by ſome, are in Fact no more than *Five:* one whereof is irregular, and the others conſtant.

Currents.

2. The *firſt* Motion is that uncertain and various kind, call'd by the name of *Currents.* The *ſecond* is the great Motion of the Ocean, every ſix Hours; by which the Waters come up to the Shoars, and fall back again alternately, twice a Day; tho with ſuch a difference as makes a Revolution once in a Month. The *third*, is the menſtrual Motion, and no other than a Reſtoration of the diurnal Motion, juſt now mention'd, to the ſame Courſes again. The *fourth* is the ſame menſtrual Motion, by which the Tides have

have an increaſe at new and full Moon, above what they have in the Quarters. The *fifth* is the half-yearly Motion; by which they riſe remarkably higher in the Equinoxes. But the *ſecond*, or great *diurnal Motion of the Ocean* is the principal Subject at preſent; and we ſhall only touch upon the reſt in the way, as they may help to explain this capital one.

3. (1.) Firſt, therefore, as to the Motion of the *Currents*; doubtleſs in the Production hereof, the Waters are either ſtraiten'd by ſome narrow Paſſages or Channels; run free from ſome open Places; or deſcend down a Declivity; or aſcend ſome Eminence; or flow upon an even Bottom; or meet with Inequalities, Riſes and Falls; or chop in with other Currents, and mix and go along with them; or elſe are agitated by the Winds, eſpecially thoſe that are Anniverſary, or Stationary, and return at certain Seaſons of the Year. And from theſe or the like Cauſes, the Waters may vary their Tendency, and their Eddies, as well in the Conſecution and Progreſs of their Motion, as in the Velocity or Meaſure of their Motion; and thence conſtitute *Currents*. 'Tis therefore manifeſt that in the Sea, the Depth of the Channel, the Intervention of ſubmarine Rocks and Caverns, the Windings of the Shoars, the jutting out of Promontories, the Interpoſition of Bays, Gulphs, Iſlands, and many other Things variouſly ſituated, may act powerfully, affect the Waters, and direct their Courſes, their Windings, and their Eddies, to all the Points of the Compaſs, according to the particular Configuration and Poſition of theſe accidental Things, with regard to one another; or as ſuch Obſtacles, Declivities, or open Paſſages happen in the way. *Origin of Currents.*

4. The Conſideration of this particular, and as it were fortuitous Motion of the Waters, muſt for the preſent be dropt; that it may not diſturb the Enquiry: for it wou'd be wrong to reject what we ſhall offer about the natural and general Motion of the Ocean, becauſe this Motion of the *Currents* does not agree, or conſpire therewith. For *Currents* are mere Compreſſions of the Water, or their endeavour to free themſelves from Compreſſion; and are accordingly particular, reſpective, and conformable to certain Situations of the Sea and Land; and to the Winds that blow in particular places. And this is the rather to be remembered and obſerved, becauſe the *general Motion of the Ocean*, now under Enquiry, is ſo mild and gentle as to be perfectly ſubdued and made ſubſervient to the force of the Currents; and be govern'd and directed by their Motion. That this is the Caſe appears plainly from hence, that the ſimple Motion of the Flux and Reflux of the Sea is not perceived in the middle of the Ocean; eſpecially where the Waters have a wide ſpread; but only at the Shoars. Whence it is no wonder it ſhou'd lye conceal'd, and be in a manner deſtroy'd by the Currents, upon account of its feeble Force; if where the Currents have the Direction, this Motion did not ſomewhat add to their Strength; and check them a little, where it is oppoſite or unfavourable. *The Motion of the Currents to be excluded.*

5. Having thus excluded the *Motion of the Currents*, we proceed to thoſe four conſtant Motions; *viz.* the *Diurnal*, the *Menſtrual*, the *Semimenſtrual*, and the *Equinoctial* Motions; the former whereof alone ſeems to excite the flowing of the Sea; whilſt the menſtrual Motion appears only to determine and *The Motion of the Flux and Reflux to be chiefly conſider'd.*

and reſtore that Motion, and the Semi-menſtrual and Semi-annual, or Equinoctial, Motions only to ſwell and increaſe it: this original Motion cauſing the Flux and Reflux of the Waters, which to a certain height overſpread the Sea-Shoars, and again forſake them, and return at different Hours with a different Force and quantity; whence thoſe three other Motions are made viſible. This Motion therefore, of the *Flux and Reflux*, muſt be treated ſeparately; and in the peculiar manner it requires.

This Motion either Undulatory or Progreſſive.

6. And firſt it muſt abſolutely be allow'd that this *Motion* is either a Motion of riſing and falling; or a Motion of Progreſſion in the Waters. By a Motion of riſing and falling, we underſtand ſuch an one as appears in boiling Water; whilſt it riſes up and ſinks down again: and by a Motion of Progreſſion, ſuch an one as we find in Water moved in a Baſon; whilſt forſaking one ſide, it riſes on the other. That this Motion is not of the firſt kind appears from hence, that the Tides vary in Point of Time, in different Parts of the World; ſo that whilſt they flow in ſome Places, they ebb in others at the ſame Hours: whereas if the Waters had no progreſſive Motion, and moved not from one place to another, but ſwell'd up from the depth of the Sea; they wou'd riſe and ſink in all Places at the ſame time. Thus we ſee that the Equinoctial and Semi-menſtrual Motions have their Effect and Operation, over the whole Globe at once: for the Tide of Flood every where riſes higher in the Equinoctial and Spring-Tides; but no where in the Quarters. In theſe two latter Motions, therefore, the Waters ſeem perfectly to riſe up and ſink down again; or like the Planets to have their *Apogeé* and *Perigeé*. But in the Flux and Reflux of the Sea, we ſpeak of, the Caſe is quite contrary: which affords a certain Sign of a progreſſive Motion.

The Tides may be owing to the Attraction of ſome celeſtial Body.

7. Beſides, if this Flux of the Waters ſhould be attributed to a bare Swelling or Riſing; let us attentively conſider how it muſt happen: for it muſt either proceed, (1.) from an increaſe of Quantity in the Waters; or, (2.) from an Extenſion, or Rarifaction thereof, in the ſame Quantity; or, (3.) from a ſimple riſing in the ſame Quantity, and the ſame Bulk or Body. But the *third* Caſe muſt abſolutely be rejected: for if the Water be raiſed up as it is, there muſt of neceſſity be a *Vacuum* left between the Earth and the bottom of the Water; becauſe there is no Body of equal Denſity to ſucceed in its Place. And for the *firſt* Caſe, if the Quantity of the Waters is increaſed, the additional Part muſt neceſſarily ſpring or flow from the Earth. But laſtly, if there be an Extenſion, this may happen either by Rarifaction, or by an *Appetite of approaching ſome other Body which attracts the Water, and raiſes it up.* And certainly this Swelling, Rarifaction, or Tendency of the Water to ſome of the celeſtial Bodies, ſeems no incredible Thing; if it be only in a moderate Quantity: and a conſiderable ſpace of Time be allow'd for ſuch a Swelling to collect and riſe [z]. And therefore that Exceſs of the Waters obſervable betwixt the ordinary Tides, and the Spring-Tides, or even thoſe that are ſtill larger, the Equinoctial Tides, being not equal to the

[z] As there is in Sir *Iſaac Newton*'s Theory: The Action of the Moon, not having its Effect upon the Water till three hours after ſhe has paſſed the Meridian.

the difference betwixt the Tide of Flood, and the Tide of Ebb; and there being likewiſe a large Compaſs of time allow'd for the making of this gradual Increaſe; the Thing does not appear contrary to Reaſon. But that ſo large a quantity of Water, as the difference between the Tide of Flood, and the Tide of Ebb, ſhou'd return ſo quick as every ſix Hours, (whence *Apollonius* idly fancied the Earth to draw in and diſcharge the Waters in the way of Reſpiration) is a Phænomenon extremely difficult to account for.

8. It may be objected, that certain Springs are ſaid to have a Correſpondence with the Flux and Reflux of the Sea; whence it might be ſuſpected, that the Waters included in the Caverns of the Earth, riſe and fall in the like manner: ſo that the Tumefaction of the Sea cannot well be attributed to a progreſſive Motion. But this is a ſuperficial Inſtance: for it may eaſily be anſwered, that the Tide of the Sea coming in, may fill up many open and cavernous places of the Earth; and thus turn the Courſe of the ſubterraneous Waters; and alſo drive back the Air ſhut up in thoſe Places; ſo as by a continued Succeſſion to protrude and raiſe the Waters of theſe Springs. And hence, this is not the Caſe in all Springs, and indeed but in few; tho it ought to be general, if the univerſal Maſs of Waters had a Nature and Property of riſing and ſinking alternately; in Conformity with the Tides of the Sea. But, on the contrary, this Phænomenon is rare, and look'd upon as extraordinary; becauſe ſuch Paſſages and Communications of Springs with the Sea, are ſeldom to be found, without ſome Obſtruction or Impediment. And to this purpoſe it may be proper to obſerve, that in deep Mines lying near the Sea, the Air is ſaid to be rendered ſo thick as to endanger Suffocation to the Diggers, at the time of the flowing of the Tide: from whence it might ſeem manifeſt, that the Waters do not riſe, where none are evidently perceived to do ſo; but only that the Air is driven back by the Tide coming in.

Objection from the ebbing and flowing of Springs.

9. There is another Inſtance produced of much greater weight; and highly deſerving of an Anſwer: for it has been carefully obſerved, that the Sea ebbs and flows upon the Coaſts of *Europe* and *Florida* at the ſame time. But this Objection will be clearly removed, by what we ſhall ſoon deliver as to the Courſe and Progreſs of the Ocean. The Sum of the Matter amounts to this, that the Waters of the *Indian* Ocean being obſtructed and ſtraiten'd by the Shoars of the old World and the New, they are protruded down the *Atlantic*, from South to North: whence it is no wonder they ſhou'd flow equally on both Shoars; as thoſe Waters do which are driven from the Sea into the Mouths and Channels of Rivers; where it is plain that the Motion of the Sea is progreſſive to the Rivers; and yet overflows the oppoſite Shoars, at the ſame time. But we muſt here, according to our Cuſtom ingenuouſly confeſs, and admoniſh Mankind to obſerve

That the Sea ebbs and flows in Florida *and* Europe *at the ſame time.*

[a] Except from the Attraction of the Moon, which in her Courſe conſtantly draws the Waters into a ſpheroidical Figure. See Sir *Iſaac Newton's Theory of the Tides*, explain'd by Dr. *Halley*, in the *Philoſophical Tranſactions*. Lowth. Abridgm. Vol. II. p. 285—288.

and remember, that if it ſhall be found by Experience, that the Tide comes in at the ſame time upon the Shoars of *Peru* and *China*, as it does on thoſe of *Europe* and *Florida*; the Notion of a progreſſive Motion in the Flux and Reflux of the Sea muſt be rejected [b]. For if the Tide riſes at the ſame time upon the oppoſite Shoars of the *Southern* and *Atlantic Ocean*, there are no other Shoars in the World, where the Reflux correſponds at the ſame time. But Judgment muſt be form'd of this from Experience; to which we aſſign it over: and in the mean time conceive, that were it known how the whole of this Matter ſtood, over all the Globe, we ſhou'd find that in ſome Parts there was ſuch a Flux at a certain Hour, as there is a Reflux in others [c]. At preſent, however, we muſt ſuppoſe for a Progreſſive Motion, in the *Ebbing and Flowing of the Sea.*

The Cauſe of the Effect, inquired into.

10. We come next to enquire from what Cauſe, and from what Correſpondence of Things, this Motion of the *Flux and Reflux of the Sea proceeds.* For all the greater Motions, when regular and conſtant, are not ſolitary, or ſingle; but have others in the Nature of Things, whereto they correſpond. And thus both the Semi-menſtrual and the menſtrual Motions of the Tides, appear to *coincide with the Motion of the Moon*; and their Equinoctial Motion with the Motion of the Sun: and again the riſing and falling of the Waters, reſembles the Apogees and Perigees of the Planets. But we deſire Men wou'd obſerve, that it does not preſently follow that thoſe Things which correſpond in Courſe and Period of Time, or even in the manner of their Motion, muſt be by Nature ſubordinate to, or the Cauſe of, one another. For we dare not proceed ſo far as to aſſert, that the Motions of the Sun, or Moon, are the Cauſes of the Motions below, which correſpond thereto; or that the Sun and Moon have a *Dominion or Influence over theſe Motions of the Sea:* tho ſuch kind of Thoughts find an eaſy entrance into the Minds of Men; by reaſon of the Veneration they pay to the Celeſtial Bodies. But in the Semi-menſtrual Motion, it will, if rightly conſider'd, appear a perfectly uncommon and ſtrange kind of Subjection, for the Tides at the New and Full Moon to be the ſame, when the Moon is different. And many other Arguments might be produced to aboliſh all fanciful Notions of ſuch over-ruling Powers; and rather lead up to the general Paſſions and Appetites of Matter; and the primary Structure of Things; from whence theſe Reſemblances proceed: not as if one was govern'd by another; but becauſe they both flow from the ſame Origins, and concomitant Cauſes [d]. Tho it is ſtill true

[b] See the *Memoirs of the Royal Academy of Sciences* at *Paris.* An. 1713.

[c] A full and adequate *Hiſtory of the Tides*, over all the Globe, is not, perhaps, hitherto procured; tho ſome conſiderable Parts may ſeem to be executed. See the *Philoſophical Tranſactions, the French Memoirs, Rohault's Phyſicks, Varenius's Geography, Newton's Principia*, and *Morhoff's Polyhiſtor*; *de Mari ejuſque Fluxu & Refluxu.* Tom. II. Part II. p. 362, *&c.*

[d] Hence we ſhou'd remember, that tho the *Doctrine of Gravity* or the Hypotheſis of the Moon's *Attraction*, along with that of the Sun, may fully account for the Phænomena of the Tides; yet there may be a more *General Principle*, which cauſes this Correſpondence. And it ſeems by no means well conſider'd, that exact Solutions of Phænomena are no Proofs that the *real Cauſes* of the *Effect* are diſcovered.

true that Nature delights in Correſpondences; ſo that that there is ſcarce any thing found ſingle or ſolitary. Whence we ought to examine with what other Motions this diurnal one of the Tides agrees, or correſponds.

Whether the Tides correſpond to the Phænomena of the Moon.

11. We may firſt enquire how this Motion anſwers to that of the Moon. And we do not find that it any way correſponds there to; except in the menſtrual Revolution: for the Motion of the Tides every ſix Hours, which is the Subject of the preſent Enquiry, in no reſpect coincides with the menſtrual Courſe. Nor again, is the Flux of the Sea obſerved to follow upon any Phaſis or Alteration of the Moon. For whether the Moon be in her Increaſe or Wane; whether ſhe be above or under the Earth; whether ſhe be elevated higher or lower, above the Horizon; whether ſhe be in the Meridian, or elſewhere; the Flux and Reflux of the Sea has no correſpondence with any of theſe Phænomena[e]. Therefore rejecting the Correſpondences of the Moon, we muſt ſearch for others.

Have an Affinity with the diurnal Motion.

12. Of all the celeſtial Motions, the diurnal Motion is the ſhorteſt; as being performed in the ſpace of twenty-four Hours: whence it ſeems moſt agreeable to refer the diurnal Motion of the Tides to this; as approaching the neareſt: tho there is ſtill a difference between them, of three Parts in four. But this does not preſs the Matter. What has much more Weight with us is, that this Motion is ſo divided, as to anſwer the Diviſions of the diurnal Motion of the Heavens; ſo that tho the Motion of the Waters is immenſely ſlower than the diurnal Motion of the Heavens; 'tis yet commenſurable with it: for ſix Hours is a quarter of twenty-four, or a quarter of the Meaſure of the diurnal Motion; and this Space is obſerved in the Motion of the Sea, with a Difference coinciding with the Meaſure of the Moon's Motion. And therefore we take it almoſt for certain, that the ſix Hours Motion of the Tides, is of the ſame kind with the apparent diurnal Motion of the Heavens.

Three Particulars comprizing the Enquiry.

13. Laying this down, therefore, as a Foundation, we proceed with our Enquiry; and conceive that the Whole may be brought to an Iſſue by proſecuting thoſe three ſeveral Queſtions; *viz.* Firſt, *Is the diurnal Motion reſtrained to the Confines of the Heavens; or does it extend to the terreſtrial Bodies?* Secondly, *Does the Ocean regularly move from Eaſt to Weſt, as the Heavens apparently do?* And thirdly, *Whence, and in what manner, proceeds the Reciprocation of the Tides, every ſix Hours; correſponding to a quarter of the diurnal Motion of the Heavens; but with a Difference coinciding with the Moon's Motion?*

The diurnal Motion coſmical.

14. (1.) As to the *firſt Queſtion*; it ſhould ſeem, that the revolving Motion from Eaſt to Weſt, is not a proper celeſtial, but a perfectly coſmical Motion: and a primary one in the larger Maſſes of Fluids; poſſeſſing all the Space from the higheſt Heavens, to the loweſt Waters; but proceeding with very different degrees of Velocity; tho in the ſame Direction: the Velocity however diminiſhing, in a regular manner, the nearer the Bodies approach to the Globe of the Earth.

[e] This is underſtood of *viſible Correſpondence*; for otherwiſe, the Author allows that the Tides may be cauſed by the Attraction of the celeſtial Bodies. See above, § 7. and 10.

That the celeſtial Motion is continued to the Earth, argued from the Motion of the fixed Stars and Planets.

15. And firſt, it ſeems a probable Argument, that this Motion does not terminate with the Heavens, becauſe it remains in force thro' all the immenſe Space which lies betwixt the fix'd Stars, and the Moon; a Space infinitely larger than that betwixt the Moon and the Earth; tho this Motion decreaſes gradually all the way: whence it ſeems improbable, that Nature ſhould of a ſudden, drop ſuch a Conſent as had been continued and gradually remitted thro' ſuch an immenſe Tract. And that the caſe is thus in the celeſtial Regions, may be argued from two Inconveniences which would otherwiſe follow. For as 'tis manifeſt to the Senſe, that the Planets have a diurnal Motion; unleſs this Motion be allowed natural, and proper, in all the Planets, we muſt neceſſarily have recourſe to the rapid Revolution of the *Primum Mobile*; which ſeems entirely contrary to Nature: or elſe to the Rotation of the Earth; which likewiſe is licentiouſly imagined, upon mathematical, and not upon phyſical Reaſons[e]. Whence, probably, the caſe in the Heavens ſhould be as we have put it.

From the Comets.

16. To leave the higher Heavens; we have an evident Inſtance of this Motion in the lower Comets, which deſcend below the Moon, and yet revolve from Eaſt to Weſt. For tho they have their own particular and irregular Motions, they ſtill participate of the Motion of the Æther, in performing of thoſe Motions; and are carried in the ſame Direction; tho they are ſeldom confined within the Zodiac; nor move in regular Spirals, or in a Figure compound of a ſtrait Line; and a Circle; but ſometimes run out towards the Poles: yet theſe retain this rotatory Motion from Eaſt to Weſt; tho greatly diminiſhed by a nearer approach to the Earth, and there revolving in leſſer Circles. This Motion is, however, ſtrong enough to carry them a very great diſtance in a ſhort time: for theſe Comets move round the whole Circumference of at leaſt the Earth and Atmoſphere, in the ſpace of twenty four Hours; with the anticipation of an Hour or two.

The conſtant Wind betwixt the Tropicks.

17. But when, by a continued deſcent, this Motion comes into thoſe Regions where the Earth acts not only by a Communication of its Nature and Virtue, which checks and deadens the circular Motion; but alſo by the material Emiſſion of its own Subſtance, in the form of groſs Vapours and Exhalations; this Motion is rendered prodigiouſly languid, and in a manner latent; tho it be not totally deſtroyed. For in ſailing between the Tropicks, where the Sea is open, and the Motion of the Air is beſt perceived, and where the Air itſelf revolves in larger Circles, and conſequently ſwifter; a conſtant Breeze is found to blow from Eaſt to Weſt: ſo that they who want a Weſt-Wind, are frequently obliged to procure it without the Tropicks. Hence it appears, that this rotatory Motion is not loſt, even in the lower Air; only becomes ſluggiſh and languid; ſo as ſcarce to be perceived out of the Tropicks. And yet even there too, in *Europe*, where the Sea is calm, and the Sky ſerene, Sailors obſerve a certain Breeze of the ſame kind, following the Sun. And we have ſome Reaſon to ſuſpect, that what is obſerved in *Europe*, where the Eaſt Wind is ſharp and drying,

[e] See Vol. II. Pag. 15, 16, 17, &c.

drying, and the Weſt Wind more general and moiſt, does not wholly depend upon this, that the former with us blows from the Continent, and the latter from the Ocean; but alſo becauſe, as the Eaſt-Wind blows in the ſame Direction with the proper Motion of the Air, it accelerates and quickens that Motion; and therefore diſſipates and rarifies the Air: whereas the Weſt-Wind blowing in a Direction contrary to that of the Air's Motion, drives the Air back upon itſelf; and condenſes it. Here alſo we might mention the common Obſervation, that the high Clouds generally move from Eaſt to Weſt; whilſt the Winds near the Earth blow in a contrary Direction. And if this be not always the caſe, the reaſon may be, that there are ſometimes contrary Winds blowing, ſome above and others below; whilſt the higher, if oppoſite, diſturb the proper Motion of the Air. And thus much may ſerve to ſhew that the diurnal Motion is not reſtrained to the Confines of the Heavens [f].

That the Waters move from Eaſt to Weſt.

18. (2.) The *ſecond* Queſtion is, *Whether the Waters regularly and naturally move from Eaſt to Weſt?* By Waters we here underſtand the collective Maſs of that Fluid which makes ſuch a large Portion of Nature, as to have a conſent with the Fabrick and Structure of the Univerſe. And we judge that this Maſs of Waters has the ſame kind of Motion with the Air, tho in a leſs degree, and by reaſon of the groſſneſs of the Body not ſo manifeſt and apparent. We ſhall therefore, for the preſent, content ourſelves with producing three eminent or *prerogative Inſtances* [g] in Confirmation of the Fact. The Firſt is, that there appears a manifeſt Motion and Flux of the Waters from the *Indian* Sea down to the *Atlantic* Ocean; and this in a ſtronger and ſwifter manner towards the *Streights of Magellan*, where there is an opening to the Weſt; and another great one in the oppoſite Part of the Globe, from the *Scythian* to the *Britiſh* Sea. And theſe Succeſſions of Waters evidently roll from Eaſt to Weſt. And here we muſt particularly obſerve that in theſe two Places only, the Seas are open; and have an opportunity of deſcribing an entire Circle; whilſt on the contrary, in the middle Tracts of the Globe, they are cut off, and ſtraiten'd by two great Obſtacles; the old and the new World; and driven into the two Channels of thoſe Twin Oceans, the *Southern*, and *Atlantic*, as into the Mouths of two Rivers, ſtretching between the South and the North; which therefore does not affect the Motion of Succeſſion from Eaſt to Weſt. So that the true Motion of the Waters may be juſtly taken from thoſe Extremities of the Globe abovementioned, where they meet with no Obſtacle; but flow natural and unreſiſted. And this is our firſt Prerogative Inſtance.

Shewn by the Motion from the Indian *Ocean to the* Atlantic.

The Difference in the Times of the Tides.

19. Our ſecond Inſtance is this. Suppoſing the Sea to flow at a certain Hour in the Mouth of the *Streights* of *Gibraltar*; it appears that the Tide muſt come in ſlower at *Cape St. Vincent* than there; ſlower at the *Lands-end*, than at *Cape St. Vincent*; ſlower at *Kings-Iſland*, than at the *Lands-end*; ſlower

[f] See the Author's Hiſtory of Winds *paſſim*; and the Specimen of animated Aſtronomy. Vol. II. pag. 15. *&c.*

[g] See the *Novum Organum*, Part II. Sect. II. *paſſim*.

ſlower at the Iſland *Hechas* than at *Kings-Iſland*[h]; ſlower at the Entrance of the *Britiſh* Channel, than at *Hechas*; and ſlower on the Eaſt of *Normandy* than at the Entrance of the Channel. Thus far is regular. But at *Graveling* the Order becomes perfectly inverted; and proceeds with a great Start; the Tide coming in here nearly at the ſame time that it does at the *Streights Mouth*. And this ſecond Inſtance we join with the firſt: for as was juſt now ſaid, we conceive that in the *Indian* Ocean, and the *Scythian* Sea, the Waters have their natural Courſe, from Eaſt to Weſt, free, open, and uninterrupted; whereas their Courſe is ſtraiten'd, and render'd tranſverſe in the Channels of the *Atlantic*, and *Southern* Oceans; and alſo beat back by the Shores which, on both ſides, ſtretch along from North to South, and allow no free paſſage to the Waters; except towards the Extremities. But the Protruſion of the Waters cauſed by the *Indian* Ocean to the North, and that on the oppoſite ſide, cauſed by the *Scythian* Sea to the South, differ immenſly in extent; by reaſon of the different Force and Quantity of the Waters. The whole *Atlantic*, therefore, down to the *Britiſh* Channel, obeys the impulſe of the *Indian* Ocean; whilſt only the upper part of the *Atlantic*, which ſtretches towards *Denmark* and *Norway*, yields to the Impulſe of the *Scythian* Sea. And this muſt neceſſarily be the Caſe; becauſe the great Iſlands of the old and new World, have ſuch a Figure and Extent, as widens to the North and ſharpens to the South; whence, reciprocally, the Seas to the South poſſeſs a greater, and thoſe to the North a leſſer ſpace. And hence that vaſt Maſs of Waters, which rolls from the *Indian* Sea, and is turned into the *Atlantic* Ocean, becomes able to protrude and drive down a Courſe of Waters, by a continued Succeſſion to the North, as it were into the *Britiſh* Sea. But that much ſmaller quantity of Water, which comes from the *Scythian* Sea, and has alſo, in a manner, a free Paſſage, in its proper Motion, to the Weſt, along the Coaſt of *America*, cannot turn the Courſe of the Waters to the South, beyond the Limits we have aſſigned, or the Chops of the *Britiſh* Channel. And in theſe oppoſite Motions, there muſt neceſſarily be ſome Limit; where they meet and conflict together; and where they muſt immediately change the Order of farther Procedure: and this happens about *Graveling*, as was above obſerved; this being the Limit of the Flux from the *Indian* and *Scythian* Oceans. And that a certain irregularity of the Tides ſhould be found about *Holland* from theſe contrary Fluxes, appears not only from the inverted Order of the Times of Flood; but alſo by conſtant Obſervation. And if this be the caſe, it muſt neceſſarily happen, that the more the Parts and Shores of the *Atlantic* Ocean ſtretch to the South, and approach to the *Indian* Ocean, the earlier the Flux will happen in Precedency; as proceeding from the proper Motion of the *Indian* Sea: and the more they extend to the North, up to the common Limit, where they are repelled by the oppoſite Torrent of the *Scythian* Sea, the later in Conſecution. And that this muſt be

[h] Neither the *Iſland Hechas*, nor *Kings-Iſland*, appear in any of the Maps that I have conſulted; nor do I know what other Names theſe Iſlands go by.

be the caſe, plainly appears by the Progreſs from the *Streights* of *Gibraltar* to the *Britiſh* Channel. Whence we conceive that the Flux on the Coaſt of *Africa* precedes, in point of Time, that in the *Streights*; and converſly, that about *Norway* precedes that about *Sweden*: tho we do not know this to be true from any Hiſtory or Obſervation[i].

The ſtrongeſt Tides in Bays, that run from Eaſt to Weſt.

20. Our third Inſtance is this. If the Seas that are incloſed on one ſide, which we call Bays, ſtretch in their Direction from Eaſt to Weſt, which is conſpiring with the true Motion of the Waters, they have a ſtrong and vigorous Flux; but if they go in the oppoſite Direction, their Floods are languid and obſcure: for the *Red-Sea* has a large Flux; and the *Perſian Gulf*, which runs more directly to the Weſt, has a ſtill larger: but the *Mediterranean*, which is the greateſt Bay of all, and the Parts of it, the *Euxine* and *Propontis*, as likewiſe the *Baltic*; all which decline to the Eaſt; are almoſt without the Tide of Flood; or have it only in a feeble manner. But this Difference appears moſt conſpicuous in the Parts of the *Mediterranean*; which ſo long as they tend to the Eaſt, or decline to the North, ſeem to lie at reſt, without much Tide; but after they turn to the Weſt, as in the *Adriatic* Sea, they have then again a remarkable Flood. Add to this, that the ſmall Reflux found in the *Mediterranean* begins from the Ocean; but the Flux from the oppoſite ſide: ſo that the Water rather follows the Courſe from the Eaſt, than the Return of the Ocean. And only theſe three *Inſtances*, we at preſent employ, with regard to the ſecond Queſtion, or Head of Enquiry.

The diurnal or coſmical Motion.

21. We might alſo offer another Proof, agreeable to thoſe already produced, but of an abſtruſer Nature; and derive an Argument for this Motion of the Waters, from Eaſt to Weſt, not only from the Conſent of the Heavens (as mentioned before;) where this Motion is in its ſtrength and vigour; but alſo from the Earth, where it ſeems perfectly to ceaſe: whence this Motion might appear to be truly *coſmical*, and to affect all Things, from the higheſt Heavens down to the more internal Parts of the Earth. We mean, that the diurnal Rotation is performed as we find it, from Eaſt to Weſt, upon the proper Poles of the North and South. For the diligence of Dr. *Gilbert* has diſcovered, that all Earth, or what we call the terreſtrial Nature, being not a ſupple or ſoft, but a rigid, or, as he calls it, a robuſt Thing; has a latent Direction, or Verticity, which manifeſts itſelf by numerous exquiſite Experiments, in the Direction of North and South. But we curb and correct this Obſervation, ſo as to aſſert the Fact only of the external Concretions, near the Surface of the Earth; without continuing it down to the central Parts: for, to make the Earth a Magnet, is a Notion formed upon a ſlender Foundation; it being impoſſible that the internal Parts of the Earth ſhould be like any Subſtance commonly ſeen; becauſe all Things, with us, are penetrated, relaxed, wrought upon, and faſhioned by the Sun, and the celeſtial Bodies; ſo as in no reſpect to correſpond with Bodies having ſuch a Situation, as that the Force of the Sun

[i] See *Philoſoph. Tranſact. Abridgm.* Vol. II. pag. 260——296.

Sun and the other celeſtial Influences and Effects, cannot reach them. But the upper Incruſtations, or Concretions, of the Earth, ſeem to participate of the Revolutions of the Heavens, of the Atmoſphere, and of the Waters; as far as conſiſtent and figured Bodies can have an Agreement with ſuch as are fluid and liquid; that is, not ſo as to revolve upon Poles, but to have a Direction and Tendency towards them. For, as every Globe, that turns upon a certain Axis, without having a central Motion, participates both of a moveable and a fix'd Nature; ſo, after the revolving Power is checked, by a conſiſtent or ſelf-determining Nature, yet the Power and Appetite of directing itſelf ſtill remains, becomes augmented and united: inſomuch that Direction and Verticity to Poles in ſolid Bodies, is the ſame Thing as revolving upon Poles in Fluids.

The ſex-horary Reciprocation of the Tides, whence.

22. (3.) The third and laſt Queſtion is this. *Whence, and in what manner proceeds the Reciprocration of the Tides, every ſix Hours, coinciding with a Quarter of the diurnal Motion, except the Difference abovementioned?* In order to clear up this Point, let us ſuppoſe the whole Globe of the Earth covered with Water, as at the general Deluge. In this Caſe, we conceive that the Water, being now in one entire Ball, and no way diſturbed, would continually move forwards from Eaſt to Weſt, every Day for ſome certain Space, tho no great one; by reaſon of the Remiſſion and Diminution of this Motion, in the Confines of the Earth. Here, by the Suppoſition, the Earth wou'd no way, by its Interpoſition, hinder, or reſtrain, the free Motion of the Waters. Let us ſuppoſe again, the Earth to be one ſingle Iſland, ſtretched out in length from North to South; which Form and Situation wou'd greatly check and obſtruct the Water's Motion, from Eaſt to Weſt. In this Caſe we conceive that the Waters wou'd proceed in their direct and natural Courſe for a Seaſon; but that at length, being beat back by the Iſland, they wou'd return at equal Diſtances, ſo as on this footing to make only one Flux, and one Reflux of the Sea, in a Day; at about the Diſtance of twelve Hours between them. Now ſuppoſe again, what is matter of Fact, the Earth divided into two Iſlands, that of the old and that of the new World, (for the Southern Continent will, by Reaſon of its Situation, here give us no great Diſturbance, no more than *Greenland* or *Nova Zembla*) and that theſe two Iſlands ſtretch almoſt over three Zones of the World; and between which the *Atlantic* and the *Southern* Oceans take their Courſes; and that theſe Oceans are no where open but towards the *Poles*. On this Suppoſition, we judge it muſt neceſſarily follow, that theſe two Obſtacles will introduce and communicate the Nature of a double Reciprocation to the whole Body of the Waters; and thus make the Quarter of the diurnal Motion; whilſt the Waters being bridled on both ſides, a Flux and Reflux of the Sea will happen twice a Day, at the diſtance of ſix Hours; as both the Acceſſion and the Repercuſſion of the Waters is double.

23. And if theſe two Iſlands were like Cylinders, or Pillars, about which the Waters throw'd themſelves, in equal Dimenſions, and ſtrait Shoars, this Motion wou'd eaſily demonſtrate itſelf to every one; tho it now ſeems to

be confounded and obſcured, by ſo great a variety of Poſition in the Sea and Land.

24. Nor is it difficult to form ſome Conjecture, as to what degree of Velocity may properly be attributed to this Motion of the Waters; and how far it may reach in a Day. For if, in order to compute this Velocity, we make Choice of ſome certain Shoars, which are leaſt mountainous or uneven, and are waſh'd by a free Ocean; and again, if the Dimenſion of the dry Land be taken betwixt the high-Water and the low-Water Mark; and this Diſtance be four times repeated; by Reaſon of the four Tides in a Day; and the product of this Number be again doubled, on account of the Tides on the oppoſite Shoars of the ſame Ocean; and ſome additional Allowance be made to the Product, for the perpendicular Altitude of the Shoars, which always riſe ſomewhat above the Channel of the Sea; this Calculation will give the Diſtance that a Globe of Water wou'd move, in a Day; provided it were free from all Obſtruction, and continually went forwards in a circular Progreſſion round the Earth. And it is manifeſtly no great Diſtance, that it wou'd thus move in a Day. *The Velocity of the Tides Motion.*

25. As to the difference which coincides with the Moon's Motion, and completes the menſtrual Period; we judge it to proceed from hence, that the Space of ſix Hours is not the exact Meaſure of the Reciprocation; as, in the ſame manner, the diurnal Motion of none of the Planets falls exactly within twenty four Hours; and that of the Moon leaſt of all: whence the Meaſure of the Flux and Reflux of the Sea is not a quarter of the Motion of the fix'd Stars, which is perform'd exactly in twenty four Hours; but a quarter of the Moon's diurnal Motion [k]. *The Motion of the Tides correſponds to the Moon's Motion.*

Precepts and Admonitions for the better proſecuting of this Enquiry.

26. BEFORE this Matter can be fully and demonſtratively ſettled, there are ſeveral leſſer Enquiries to be made; and in particular we recommend the following to future Diligence.

27. (1.) Enquire whether the Hour of Flood about the Coaſt of *Afric* precede the Hour of Flood about the Streights of *Gibraltar*; and in like manner whether the Hour of Flood about *Norway*, precede the Hour of Flood about *Sweden*; and whether this precede the Hour of Flood about *Graveling*.

28. (2.) Enquire whether the Hour of Flood about *Brazil*, precede the Hour of Flood on the Coaſts of *New Spain*, and *Florida*.

29. (3.) Enquire whether the Hour of Flood on the Coaſt of *China*, do not nearly coincide with the Hour of Flood on the Coaſt of *Peru*; and again with the Hour of Ebb on the Coaſts of *Africa* and *Florida*.

[k] See Sir *Iſaac Newton*'s Theory of the Tides.

30. (4.) Enquire how the Hour of Flood on the Coaſt of *Peru*, differs from that on the Coaſt of *New Spain*; and particularly how the Differences of the Hours of Flood ſtand in both the Shoars of the Iſthmuſes in *America*; and again how the Hour of Flood on the Coaſt of *Peru*, correſponds with that on the Coaſt of *China*.

31. (5.) Enquire into the heights of the Tides, on different Shoars, as well as their Times: For altho high Tides are generally cauſed by low Shoars; yet they ſtill participate of the true Motion of the Sea; according as that proves favourable or oppoſite.

32. (6.) Enquire, particularly, into the State of the *Caſpian* Sea, which is a large Collection of Waters, excluded from a free Communication with the *Ocean*; to ſee if it has any Flux or Reflux; and in what manner they happen: for we conjecture that this Sea may have a ſingle, but not a double Tide, in a Day; whilſt the Water forſakes the Eaſtern Shoar, and riſes to the Weſtern of that Sea.

53. (7.) Enquire whether the Tides in the New and Full Moon, and in the Equinoxes prove high, and large, in different Parts of the World at once: not underſtanding by *once*, the ſame Hour; for the Hours differ according to the Appulſe of the Waters to the Shoars; but on the ſame Day.

34. (8.) For want of fuller Information, this *general Enquiry* of the Ebbing and Flowing of the Sea, cannot be juſtly continued down to an Explanation of the Conſent of the menſtrual Motion of the Sea-Tides with the Motion of the Moon; whether *theſe Motions proceed from a Subordination to the Moon*; or, *whether they both have one and the ſame Cauſe:* which ſhou'd be farther examined.

35. (9.) The preſent *Enquiry* is connected with that relating to the Earth's diurnal Motion; which ſhou'd therefore be clear'd up, before any thing is determined upon this *Head*. For if the Tides of the Sea, be, as it were, the laſt Extremity of the diurnal Motion; it will follow that the Globe of the Earth is fixed; or at leaſt that its Motion is much ſlower than the Motion of the Waters [1].

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[1] This beginning of an Enquiry about the *Cauſe of the Tides*, is a poſthumous Piece, that occurs among the *Scripta* publiſh'd by *Gruter*; and ſeems not intended to have come abroad, till, in the Author's uſual manner, it had been brought nearer to Perfection. But imperfect as it is, it may deſerve the place here aſſigned it, among other imperfect Pieces, deſignedly wrote, not in the *inductive* but ordinary Manner. And theſe few *Eſſays* are all that we find the Author left fit to enter this fifth Part of his *Inſtauration*.

APPEN-

APPENDIX

TO THE

Fifth and Sixth PARTS

OF THE

INSTAURATION.

BRITISH MUSEUM

APPENDIX
TO THE
Fifth and Sixth PARTS
OF THE
INSTAURATION.

1. HAD the fifth Part of the *Inſtauration* been finiſhed, according to the Author's Deſign; it would have contained, not only the beſt Philoſophy he was able to lay down, for the Time; but alſo the Rudiments of a much more perfect one, reſerved for the ſixth and laſt Part of his great Undertaking [m]. *The Deſign of the fifth Part of the* Inſtauration.

2. This double View of the Author may ſeem to increaſe the Difficulty of compleating a Philoſophy, whereof he has left us no more than a few Sketches; without any explicit Directions for conducting and bringing the whole to a Period.

3. It appears, however, that this *Firſt Philoſophy* was to be general, and copied after Nature, in her full Extent and Latitude; ſo as to include the Hiſtory of the Heavens, of the Earth, and of Man: tho the whole was intended only as an Eſſay, or temporary Structure, to be raiſed by the ordinary Means; without the aſſiſtance of the *Art of Induction:* which Art being afterwards employ'd upon it, was to afford fit Matter for the *Second* or *Perfect Philoſophy.*

4. And if a tolerable *Firſt Philoſophy* might have been wrote a Century ago, when Natural Knowledge had been but little cultivated; doubtleſs ſuch a Philoſophy may be wrote at preſent, to greater Advantage; on account of the numerous Experiments and Obſervations that have of late been made in the ſeveral Countries of *Europe*, for promoting all the Parts of Natural Knowledge. *May be advantageouſly executed at preſent.*

5. At leaſt it cannot be unſeaſonable, for Perſons acquainted with the Lord *Bacon*'s Views, to try what may at preſent be done towards forming a *Firſt Philoſophy* from the many Portions of Natural Hiſtory that have been

[m] See Vol. I. p. 15, 510. Vol. II. p. 404, 405. Vol. III. p. 18, 578, 579.

written

written ſince his Time; beginning with thoſe himſelf has left us, and deſcending gradually to the Labours of later Writers, and the Works of the ſeveral Societies of *Europe*, inſtituted for the improvement of Knowledge.

Not already extant.

6. If a Philoſophy of this kind be ſuppoſed already extant, in the Writings of M. *Rohault*, *du Hamel*, or other Syſtematical Authors; we muſt remember, what was before intimated, that the *Firſt Philoſophy* of the Lord *Bacon* was to be general, and formed upon the Model of the Univerſe; and that it was to afford Matter ready digeſted and prepared, as much as poſſibly it cou'd be without the *Art of Induction*, for forming a *Second* or more perfect axiomatical Philoſophy. In which Light, the Works of the abovementioned Philoſophers, with others of the ſame kind, may, ſo far as they are found ſolid and ſerviceable, be received into this *Firſt Philoſophy* as Parts; but cannot be allow'd to execute the whole.

How to be ſupplied.

7. Perhaps the End might be anſwered, in ſome conſiderable degree, by digeſting into a proper order, the pure Philoſophical Matters to be found in the Writings of Dr. *Hook*, Mr. *Boyle*, Mr. *Evleyn*, Dr. *Becher*, M. *Paſchal*, M. *Mariotte*, Dr. *Stahl*, and Sir *Iſaac Newton*; in the *Philoſophical Tranſactions*; the *French Memoirs*, the *German Ephemerides*, the *Acta Eruditorum*, &c. ſo as hence to form a kind of general Syſtem of Philoſophy; to be amended from time to time, as new Improvements and Diſcoveries ſhall be made. And unleſs ſomething of this kind be done, it ſhou'd ſeem that little Advantage can be rationally expected from all the Labour hitherto beſtowed in collecting and regiſtring ſuch numbers of Obſervations and Experiments, as are to be met with in thoſe Writings.

The Advantages of attempting it.

8. An Attempt in this Way might alſo ſerve to ſhew the Sufficiency or Inſufficiency of our preſent *Natural Hiſtory*; what Progreſs has been made in the Improvement of Knowledge ſince the Lord *Bacon*'s time; how far his Directions have been followed; what is farther wanting towards compleating the Deſign of his grand *Inſtauration*; and, in particular, how far we are prepared to enter upon the laſt Part thereof, the *Philoſophia Secunda*.

9. Again, a *Firſt Philoſophy* of this kind might have a great tendency to promote the Accompliſhment of all the Parts of the *Inſtauration*; and, conſequently, the Felicity of Mankind; which is naturally founded in the Perfection of Philoſophy. And, certainly, to procure ſuch a Firſt Philoſophy, upon this Plan, were no difficult, or tedious Taſk; if properly recommended to a competent number of Hands.

The Second Philoſophy *more tedious and difficult.*

10. But to execute the *Second or Axiomatical Philoſophy*, is a Work of much greater Labour, and length of Time; for, to ſay the Truth, the preſent State of Knowledge ſeems by no means ripe enough to afford it, in any tolerable Perfection; and perhaps ſome Ages are ſtill required to bring it to Maturity. So that all we can do, at preſent, is to labour the under Parts of this grand Structure; and recommend the finiſhing of it to Poſterity.

Yet not to be deſpaired of.

11. We may, however, form ſome tolerable Idea of this future Philoſophy; be convinced that it is within the human Abilities to procure; and aſſured, that ſome conſiderable Foundation is already laid for it. Thus much cannot well be doubted of by thoſe who underſtand the Nature and

Uſe of the Author's *Novum Organum*, and his ſeveral Portions of *inductive Hiſtory*, to be met with in the *Sylva Sylvarum*, *Hiſtory of Life and Death*, &c [n].

12. Nay, if Men would in earneſt bend their Endeavours this way; and were poſſeſſed of a juſt and actuating Notion of the Thing intended; the Work might be greatly ſhorten'd in point of Time: But to poſſeſs Mankind with a juſt Notion of the Thing, is no ſmall part of the Difficulty; and cannot be removed without ſome Labour of Thought on their own ſide. And, indeed, unleſs the *Novum Organum* be underſtood, and its force perceived and felt, there are little Hopes of making the generality of Men ſenſible of their own Philoſophical Abilities. *The Time of bringing it to Perfection might be ſhorten'd.*

13. This great Work, therefore, muſt, of neceſſity, be conducted by thoſe who underſtand the way of working with Engines; where the Strength of others may be advantageouſly employ'd, to an End which the Labourers will not be eaſily apprized of.

14. The Things wanting to perfect the Deſign are; (1.) a compleat *Inductive Hiſtory*; or a full ſet of Enquiries into Nature, with a direct View to the forming of Philoſophy; (2.) The Completion of the Art of Induction, or the Execution of the whole Deſign of the *Novum Organum*; (3.) The due Application of this Art to the Matter of Inductive Hiſtory; ſo as thence to deduce *Axioms* of the higheſt Order, for Practice, Contemplation, and human Uſes; (4.) A Collection of theſe Axioms ranged in exact Method; ſo as to form one ſingle Syſtematical Philoſophy, in Conformity with Nature; and exhibit a true Draught, or Copy, of the Univerſe, with all its Laws; and (5.) a ſhort but full Explanation, annex'd to each Axiom; ſo as to break it into Parts, and bring it down to particular Caſes, both of Theory and Practice. *The Particulars required for proſecuting the Work.*

15. A Philoſophy procured in this manner is the ultimate End of the *Inſtauration*; an End worthy of the Author; and fixed with true Judgment, as a deſirable, yet poſſible Pitch of Perfection; to which human Knowledge may arrive, by a right Uſe and Application of the human Faculties. *The* Second Philoſophy *the End of the* Inſtauration.

16. A little to exemplify and illuſtrate the Method of raiſing ſuch a Philoſophy; let us ſuppoſe, (1.) A particular Inductive Hiſtory carefully wrote, or a rigorous Enquiry made about the Buſineſs of common Fermentation; ſo as to regiſter all the prerogative Inſtances, capital Facts and Phænomena, or principal Changes obſerved in the ſeveral Subjects employ'd; as Grapes, Malt, Treacle, Sugar, *&c.* (2.) That theſe Inſtances being carefully ranged or tabled, and thorowly conſidered, reduce themſelves, by the Method of Rejection, or Art of Induction, to this ſingle *Axiom*; viz. That *a ſaccharine Matter is the Baſis of Wines, Beers, Vinegars, and Brandies.* (3.) This Axiom wou'd then be the Reſult of the Enquiry; and, like an Algebraical Expreſſion, or general Theorem, contain ſeveral Arts wrapped up in few Words. But, (4.) To verify this Axiom, and render it fit to be relied on, *The way of forming it exemplified.*

[n] See Vol. I. p. 16.

or

or worthy to enter the *Second Philoſophy*; it muſt be verified by particular Experiments. Thus, if a ſaccharine Matter be the Baſis of Wines, *&c.* let Art try to obtain a Sugar from all the Subſtances that afford Wines, *&c.* And (2.) again, if a ſaccharine Matter be the Baſis of Wines, *&c.* let Wines, *&c.* be made from Sugar. The Experiments therefore muſt be tried; and if Sugar can be procured from all fermentable Subſtances; if theſe Subſtances will not afford Wines, *&c.* after the Sugar is got out; and if Wines, *&c.* can be made from Sugar; the *Axiom* may appear duly confirmed; or verified. (5.) To draw out the ſeveral Arts abovementioned, and ſhew how they may all be hence improved or perfected, requires a particular Explanation, under the ſeveral Heads of Wines, Beers, Vinegars and Brandies; or the Arts of the Wine-maker, Wine-Cooper, Vintner, Brewer, Vinegar-maker and Diſtiller; each whereof may be improved, and ſome of them perfected by this Diſcovery.

At leaſt a Collection of imperfect Axioms *may be deduced from Enquiries.*

17. The Axiom here ſet down is purpoſely made Choice of, becauſe it was the Reſult of an Enquiry [9], proſecuted with ſome Diligence; and if the Axiom be not abſolutely perfect; yet it affords a highly uſeful phyſical Canon: by means whereof many conſiderable Things may be perform'd. And, doubtleſs, it wou'd prove of great Advantage to have a Collection made of ſuch Axioms, which tho not perfectly true, or thorowly verified, ſhou'd yet hold in moſt Caſes, or rarely fail; and ſerve as uſeful Guides tho not infallible. But then ſuch Axioms muſt always be the Reſult of Enquiries; and be found, not made: otherwiſe they are of no validity; and can never be truſted.

The Method general.

18. The Example above propoſed is taken from Phyſicks; but the ſame Method of Inveſtigation is equally fitted for improving all the Parts of Knowledge; ſo that Civil Policy, Ethicks, Law, Medicine, and the other Branches of Science, may be perfected in the ſame manner: whence it appears, that the Lord *Bacon* has thus open'd a Way for bringing Philoſophy to its higheſt Perfection; and Mankind to their greateſt temporal Happineſs.

29 MR 64

[9] See Vol. III. p. 224.

The End of the THIRD VOLUME.

A General

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